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An international bridge design competition is announced by the Royal Hungarian Minister of Commerce. Two bridges of 312 meters and 332 meters respectively are to be built across the Danube at Budapest, and prizes of $6,080 and $4,050 are offered for the first and second best designs. If the first prize design fulfills certain specified conditions, it will receive $2,030 in addition. The full terms of the competition, and maps and profiles showing the location of the bridges, can be obtained at every consulate general of Austria-Hungary. Mr. Theodore A. Havemeyer, 33 Broadway, is the Austrian Consulate-General in New York city.

A ship canal scheme, from Toledo to Cincinnati, O., is started by the Cincinnati Board of Trade, and funds are being raised for a preliminary survey. The project includes the use of the Maumee and Miami rivers as far as possible, and the deepening and widening of the Miami and Erie Canal.

A belt flying off is by no means an uncommon accident in an electric lighting station, but the engine driving the two Edison dynamos which supply current for the lamps on the Ferris wheel at the Columbian Exposition performed the other day the remarkable feat of throwing off its under belt while the top one remained in place on the pulley. The two dynamos are driven by belts mounted tandem on the engine flywheel, and the foundations have settled somewhat since the plant was put in place, altering the relative alinement of the engine and dynamos. The astonishment of the engineer at the extraordinary behavior of the belts did not prevent him from closing the throttle. The two dynamos were coupled in parallel, and the engine was stopped just in time to save a burn-out on the dynamo which was left running and on which the whole load came, when the other stopped.

St. Louis, Mo., through its Mayor and City Council, is objecting to the proposed discharge of Chicago sewage into the Mississippi River through the drainage canal now being constructed. Health Commissioner Holman is quoted as introducing the resolution and he talks of an injunction obtained from the U. S. Courts if Congress does not stop the proposed canal.

The Pasadena & Mt. Wilson Ry., in northern California, is the newest steep grade mountain railway; it was formally opened on Aug. 23, although cars have been running for several weeks. The upper section of the line is a cable incline with a maximum grade of 62%. The road was described in our issue of March 26 and July 14, 1892.

A party of forty French engineers, on their way to the World's Fair at Chicago, has been entertained by the American Society of Civil Engineers. A breakfast was given them at the Engineers' Club, and during several days they were driven about the city, visited the New Croton Aqueduct, the Washington and Seventh Avenue bridges, the Broadway Cable-road, the Manhattan Elevated, power plant of the Signal Service, etc. The chairman of the committees of the Society in charge were Mr. Thomas C. Clarke and Charles Warren Hunt.

The New York Rapid Transit Commission at its meeting on Sept. 1 showed a strong disposition to return to the underground plan of construction. Commissioner Inman spoke strongly in favor of an underground system as the only satisfactory one. Commissioner Porter said he believed underground roads would be preferable, and Commissioner Starin characterized elevated roads as mere makeshifts.

Ten million persons paid for admission to the Columbian Exposition during May, June, July and August. Of this number 3,523,312 were registered during August.

The number of competing architects who have submitted plans for New York's new city hall is 133.

The preservation and duration of iron bridges form the substance of a letter written by Sir William Arrol, the builder of the Forth bridge, to Councilor King, of Glasgow, who had assumed, in an argument, that the life of an iron bridge was only 40 years. Sir William says this life depends on what materials and care are used for the preservation of the bridge. He bought the old Hammersmith Bridge, London, for use as temporary plant in erecting the Forth bridge. This London bridge had been up for 62 years, and many of the parts being inaccessible were not painted since its erection. He found these parts in good preservation, in fact, "quite as good as when they left the shop," and says the reason for this preservation was the fact that they were originally painted with genuine white lead. The Bonar bridge, recently replaced by Sir William Arrol, had been in use 80 years, yet the iron work was perfectly good.

The most serious railway accident of the week was the bridge disaster at Chester, on the Boston & Albany R. R., Aug. 31, which caused the death of 17 persons and the injury of over 30. The circumstances are fully detailed on another page of this issue.—A freight train on the Gulf, Colorado & Santa Fe Ry. was wrecked near Belleville, Tex., Aug. 31, by running into a burning bridge. The engineer was killed.—A freight and accommodation train went through a bridge near Streator, Ill., on the Chicago, Burlington & Quincy R. R., on Sept. 2, and fell to the bottom of a 25-ft. ravine. The wreck took fire, probably from oil lamps, but the flames were put out by the trainmen. Two men were killed and a dozen were injured. The accident is thought to have been caused by some bridge iron which was loaded on one of the cars of the train becoming misplaced and striking the bridge trusses.

The inherent dangers of permissive blocking were illustrated in an accident on the Chicago & Erie near Disko, Ind., Aug. 25. A fast freight train burst an air-brake hose and stopped. The second section was following so closely that it crashed into the rear of the train before it could be stopped. It is fair to say that this is claimed to be the first serious collision to occur line since the Mozier block system, described in our our issue of May 11, was put in force. Passenger trains are run under the absolute block; but second class trains and extra freight trains follow each other five minutes apart, under the green block.

The brakes on a car of the Avondale Electric Ry., in Cincinnati, failed while the car was descending a grade, and it ran for nearly a mile before leaving the track. The accident caused the death of four persons and the injury of 22.

Screwing up a bolt under steam pressure caused the death of one man and the serious scalding of another in Philadelphia, Aug. 31.

A test of two 300-lb. Holtzer projectiles at the government proving grounds at Sandy Hook on Sept. 5 gave very satisfactory results. Two projectiles were discharged at an armor plate of open hearth, oil-tempered steel 9 ins. thick from an 8-in. gun at a velocity of 1,624 ft. per second. The first projectile fired pierced the plate and backing and was lost, but there were no evidences that it was broken. The second projectile pierced the plate and was buried in the earth backing, and was recovered. It showed no appearance of injury, although no exact measurements were made. The projectiles were manufactured by the Midvale Steel Co., of Bethlehem, Pa., who control the Holtzer process in this country.

The members of the Peary expedition have been safely landed at Bowdoin Bay, West Greenland, according to news brought by the steamer "Falcon," which conveyed them to that point. Upon landing the party began immediately the construction of buildings for a headquarters, which were nearly completed at the date of the departure of the "Falcon" for home. The voyage was without especial incident.

Hailstones over 3 ins. in diameter fell at Rome, N. Y., Aug. 27, according to a letter to this journal from Mr. Charles C. Hopkins, M. Am. Soc. C. E., accompanied by a photograph of some large specimens. The stones fell nearly vertically, and so little damage was done except to tin roofs and skylights.

The great storm which swept up the south Atlantic coast on Aug. 27 proves to have caused greater destruction of life and property than any disaster in the country since the Johnstown flood. The Sea Islands on the South Carolina coast were the worst sufferers, but many lives were lost and much property was destroyed in Georgia and North Carolina as well. The wide extent of the calamity and the isolated character of the communities affected make an accurate statement of the loss of life impossible. The coroner of Beaufort Co., S. C., has reported the list of the known deaths in the vicinity of Beaufort as 758. The chief cause of the great loss of life was the extremely high tide, which inundated the low sand spits and overwhelmed the inhabitants before they could make their escape to higher ground.

The Nicaragua Canal Construction Co. was placed in the hands of Thos. B. Atkins as receiver on Aug. 31, the company being unable to meet a draft of $9,000 Mr. Atkins is treasurer of the Maritime Canal Co., and is reported in a newspaper interview as stating that the company's embarrassment was merely due to the hard times, and that the statement of the affairs of the Construction Co., when made, would be a favorable one.

Work on the Chicago drainage canal is to be given to its unemployed citizens on a somewhat different plan from that stated in our last issue. On the sections which were let to McArthur Bros. and Harley, where the contractors have abandoned the work on account of a dispute as to whether the cemented conglomerate encountered should be classed as rock or as glacial drift, an agreement has been reached by which the contractors are to go on with the work of building levees to shut out the flood waters of the Desplaines. The city will pay them for all expenses in labor and material used and 15% in addition for supervision of the work and use of their plant. Booths for the registry of applicants for work were opened on the Lake Front on Sept. 3, and about 900 men were registered on the first day.

A trolley street sprinkler is being considered in Brooklyn. The idea is to use a closed car, with a 2,500 gallon tank, operated from the trolley wire. A swinging 3-in. perforated iron pipe, attached to the front platform, would water the side up to the curb, while beneath the car is another perforated pipe which would sprinkle the track itself.

The block system as applied to the cleaning of the asphalt paved streets of Buffalo, N. Y., is an eminent success, says the "Commercial" of that city. This block system, however, is really only supplementary to the general cleaning system in the business part of the city, and is intended to gather up all droppings, scraps and refuse scattered between regular cleanings. A man or boy now uses an iron scraper to gather into piles the refuse, and from there it is regularly taken up by carts. The present force numbers 49 men, at 15 cts. per hour, with 6 carts. Hereafter the dirt is to be placed in special barrels instead of being gathered into heaps, and these barrels will be emptied by carts as fast as they can make their rounds. The proposed system is practically the London dust-bin and sweeper system long in use in the busier streets of that city.

Mr. F. W. Webb, Chief Mechanical Engineer of the London & Northwestern Ry., objects to our criticism of the brake gear on the train exhibited by that road at the Columbian Exposition, as published in our issue of July 20, page 56. Mr. Webb informs us that the brake on engine and tender are worked by steam and are applied at the same time that the vacuum brake is applied. We make the correction with pleasure. Our correspondent understood from the attendant in charge that the tender brake was worked by hand only, and as the man appeared familiar with the brake gear he took him at his word.

Competitive designs are invited for a million dollar state capitol building at Olympia, Wash. The architect receiving first prize is to be rewarded by "selection as architect of said building and the acceptance of his plan and design." The other prizes are $1,500, $1,000 and $500. Competitors have until Dec. 14 to submit their designs, which are to consist only of four elevations, plans of each story, one elevation and one perspective. Maps of the site and any other information may be had by addressing the State Capitol Commission, Olympia, Wash.

TRACK EXHIBITS AT THE WORLD'S COLUMBIAN EXPOSITION.

Of modern completed track there is but a small exhibit, but there are extensive specimens of historical track and of individual modern track appliances. The Pennsylvania R. R. and the Baltimore & Ohio R. R. have each an exhibit of old track and track appliances of railways in this country, while Mr. Haarmann, of Germany, has an interesting exhibit of the same character relating to European railways, but also including modern track of various types of construction. Of these we shall have more to say in another article. It may be noted, however, that the Pennsylvania R. R. shows a 99-lb. T-rail 7½ ins. high and 4⅞ ins. wide over the base, which was used on the Camden & Amboy R. R. in 1848, together with short angle bars having three bolts (an early example of the hinge joint as now used with five bolts in India) and two round holes in the flange. In modern track proper the foreign exhibits are far ahead of the American exhibits, since the ordinary everyday standards of the former are superior to and more substantial than the very exceptional standards of the leading American lines. The points of superiority are pointed out further on in this article, and we also offer some suggestions as to the improvement of the American track as it exists to-day.

Modern American Track.

The New York Central & Hudson River R. R. has a 30-ft. section of four-track line laid with 100-lb. rails on steel ties. The rails have already been illustrated in our columns, and the ties are of the pattern also illustrated, except that instead of having pockets stamped to receive the rail clamps, the upper surface of the tie is quite plain. The form of tie differs essentially from that of the Hartford tie first tried on this road, and is the design of Mr. Katte, Chief Engineer, following in general form the Post steel tie extensively used in Europe. The tie is of pressed steel, of trough section, with the ends and middle depressed, the middle portion being covered with the broken stone ballast. The ends are closed and the section is narrower and deeper at the middle than at the rail seat. The ties are manufactured by the Schoen Mfg. Co., of Pittsburg, Pa., and that company includes one in its own exhibit. The 100-lb. rails were rolled by the Lackawanna Iron & Steel Co., of Scranton, Pa., in 1892, and are laid with broken supported joints spliced by 36-in. angle bars with six Harvey grip thread bolts, requiring no nut lock. The rails are secured by clamps having inclined top surfaces, so that the bolts (also with the Harvey grip thread) are at an angle to the rail, and have, therefore, a wedge action in resisting the lateral thrust of the rail. Under its own exhibit of engine and cars, this road has 100-lb. rails spiked to wooden ties in the usual way. The Pennsylvania R. R. has a complete section of four-track line with cross-over road, switches, and track and ground signals. The rails weigh 100 lbs. per yd., and are in lengths of 100 ft., spiked in the ordinary manner to wooden ties laid in broken stone ballast. They are laid with broken suspended joints spliced by 34-in. angle bars and six bolts, while two heavy lag screws fasten the flange of each angle bar to the joint ties. The switches and signals are interlocked, and the latter are operated by compressed air, electrically controlled from a cabin over the Pennsylvania R. R. building. The system used is that of the Union Switch & Signal Co., of Pittsburg, Pa., and forms the whole of that company's exhibit. In conformity to the practice of the Pennsylvania R. R. the running faces of the signal blades are painted red (home) and green (distant), without the usual white band which serves to accentuate the visibility of the signal. In regard to the track itself, it is somewhat curious to note that the Pennsylvania R. R., while using lag screws to hold the angle bars to the ties and thus hold the rails and ties firmly together, still uses the ordinary spike for its standard rail fastening, even with 100-lb. rails, and the same is true of all American railways. Heavy rails are being introduced, with various forms of joints and improvements in frogs, switches, tieplates, etc., but the rail fastening is conspicuously neglected. The New York Central R. R. will try a promising screw spike and clamp fastening (described further on), and it is to be hoped that the Pennsylvania R. R. will extend the use of its lag screws to the intermediate ties. This matter of rail fastenings is one which has been too long neglected by American railways.

Modern Foreign Track.

There are several examples of complete modern track of foreign railways, including those of the Prussian State Railways, the Gotthard Railway, the New South Wales Government Railways and the London & Northwestern Railway and Great Western Railway, of England. The track of the Prussian railways is laid with heavy T-rails on steel ties of trough section, level and of uniform section from end to end, and having the ends closed by bending down. The rails rest on steel tieplates, having a lug to hold the outer edge of the rail base, and a rib on the inner edge. A clamp holds the inside of the rail flange and bears against this inner rib on the plate, being held in place by a vertical bolt with nut and washer on top. The joints are square and suspended, spliced by double angle bars with lower webs below the rail, the ends of the bars projecting over the ties and being notched for the clamps. One section of these tracks has halved or scarfed rail joints, with a scarf 8½ ins. long, and a space of ⅜ in. between rail ends. With ordinary joints the splice bars are 28 ins. long, with bolts 4½, 5 and 4½ ins. c. to c. With scarf joints they are 26 ins. long, with bolts spaced 5, 4 and 5 ins. c. to c. The German locomotives exhibited rest on heavy rails with wooden ties having the upper edges beveled, the ties being about 9 ft. long. Metal tieplates 6⅜ ins. wide by 7¼ ins. long (lengthways of tie) are placed between the rail and tie. The rails are fastened by three lag screws (two inside 3¼ ins. c. to c.) with round heads 2 ins. diameter bearing on the rail flange, and having a square projection on top for a vertical socket wrench. The joints are spliced by angle bars, as above, but the bars are only 19½ ins. long, with bolts spaced 5 ins. c. to c. The steel ties of the Prussian State Railways (made by the Union Iron Works, of Dortmund) weigh 101.20 lbs., and cost $1.28 each. The Gothard Railway track, as laid on the tunnel sections, consists of heavy T-rails 5½ ins. high, 5⅛ ins. wide over the base and with a head 2¾ ins. wide. These rails are about 39 ft. long, and are carried on 16 steel cross-ties to a rail length, the ties being about 8 ft. 6 ins. long and spaced about 14 ins. at the joints, 22 ins. next to joints and 30 ins. intermediate. The ties are of trough section, 5 ins. wide at the rail seat and 9½ ins. over the bottom. The sides are pressed together at the middle and the ends are turned down. The rails are fastened on each side by bolted clamps 2½ ins. square, the nuts being hexagonal and 1 in. deep, with Grover spring washers. The track is laid with square suspended joints, spliced by grooved angle bars 23½ ins. long, with four bolts spaced 6¾ ins. c. to c., giving a very short distance between the bolts and ends of the bars, especially as compared with those of the Prussian track. The flanges of the bars are slotted for the rail clamps. The joint bolts have heads 1½ ins. square, and the hexagon nuts and Grover spring washers are on the inside of the rails. The rails weigh about 96½ lbs. per yd., and the ties weigh 145.2 lbs. each. This piece of track is a part of the extensive iron and steel exhibit of Stumm Bros., of Germany.

The New South Wales Government Railways show tracks laid with T-rails and with double-head rails in chairs. The flange or T-rails are about 4⅞ ins. high and 5⅛ ins. wide over the base. They rest on ironbark ties 9 ft. long, 10 ins. wide and 5 ins. thick, spaced about 30 ins. c. to c., and are secured on the outside by lag screws with heads 1¾ ins. square, and on the inside by spikes with heads 1½ ins. square, the heads being much heavier than those of American spikes. The rails are spliced by 18-in. plain fishplates, with four bolts spaced 4½, 5 and 4½ ins. c. to c., having heavy button heads, oval necks, and having hexagon nuts on the outside. The double-head rails are about 5½ ins. high, with top head 2 9-16 ins. wide. They are carried in chairs 14½ ins. long by 7½ ins. wide, with holes for four round spikes, but only two spikes are used at a time, except at the joint ties, where two spikes are used on the outside. The wooden keys are on the outside of the rails. The ties are similar to these for the T-rails, and some of these ties are exhibited which have been in service for 23 or 24 years under continuous traffic, and are in excellent condition. The holes are bored when the ties are in the track. The track under the London & Northwestern Ry. locomotive has double-head rails with the Webb steel cross-ties, riveted chairs, and steel keys outside the rail. The ties, however, have closed ends, although many of the Webb ties, as used in England, have open ends, but the bracing of the open-end Webb ties on the Pennsylvania R. R. by timbers placed between the steel ties and the wooden ties of the adjacent track is evidence that a greater end area is required than that of a mere edge of steel. The track under the cars has similar rails in cast iron chairs on wooden ties, each chair fastened to the tie by two lag screws and two round spikes. The rails are fastened by wooden keys on the outside of the rail. The Great Western Railway, of England, has an interesting track exhibit, including a bridge rail with skew or bevel joint of 20°, laid in 1838 (on longitudinal timbers), between London and Maidenhead. The locomotive "Lord of the Isles" also stands on the standard broad (7 ft.) gage track which only became obsolete in 1892. It consists of rails of bridge section fastened by lag screws to longitudinal timbers with transverse timbers or transoms at intervals. A continuous bearing of wooden plates 1 in. thick is placed between the rail and longitudinal. There is also a section of the company's present standard track, consisting of bull-head rails weighing 86 lbs. per yd., carried in cast iron chairs secured to creosoted wooden ties by two lag screws to each chair. The rails are laid with square supported joints, spliced by short fishplates with four heavy bolts having heads and nuts 1¾ ins. square, the latter being on the outside of the rail. The wooden keys which hold the rails in the chairs are also on the outside. The splice bars butt against the ends of the chairs. In addition to the above there is a set of rail sections showing the development of the bridge and T-rails used with longitudinals, and of the double-head, bull-head and T-rails used with cross-ties. They include an 84-lb. T-rail of 1856, a 99-lb. Barlow rail of 1857 and the 120-lb. bridge rail laid in the Severn Tunnel.

The Southern Railway, of France, exhibits drawings of its standard track, which consists of 75-lb. double-headed rails carried in cast iron chairs secured to wooden crossties by two lag screws to each chair. The rails are 5.36 ins. high, with square suspended joints, spliced by plain fishplates. The wooden keys fastening the rails in the chairs are on the outside of the track. The rails are 36 ft. long, with 12 or 14 ties per rail-length, the ties being 5 × 10 ins. × 8.69 ft. long. At the joints and middle of rails the ties are spaced 24 ins. c. to c., and the intermediate ties are spaced 32.6 ins. with 12 ties, or 39.2 ins. with 14 ties to a rail. The close spacing at the middle of the rail is to enable four men to rapidly replace a broken rail with two rails 18 ft. long.

Ties and Tie-Plates.

Of wooden ties there is naturally a small exhibit, including only those of the track exhibits, and some specimens in the railway collection of the Foresty Division of the U. S. Department of Agriculture. This collection is a comprehensive and interesting one, including specimens and models of metal ties, tie-plates, rail braces and fastenings, spikes, etc. There is also a set of 32 colored drawings of the various forms of metal ties used throughout the world, exhibited by Mr. E. E. Russell Tratman, of New York. The wooden ties include pieces creosoted by Eppinger & Russell, of New York, and other pieces treated by the zinc-tannin process by the Chicago Tie Preserving Co., some of these latter pieces being cut from oak and pine ties which have been in service for 11 and 12 years on the Atchison, Topeka & Santa Fe R. R. A redwood tie of "black" redwood (the best quality) is shown which has been in service for 23 years (1870 to 1893) on the Southern Pacific Ry., near San Jose, Cal. The ordinary life of these ties is five years and upward, depending upon the traffic, but they rarely fail from decay, being cut out by the rails, which, however, is now prevented by the use of the iron tie-plates recently illustrated in our columns. Another long service tie is one of red fir, which was in the track under light traffic on the Central Pacific R. R., near Hot Springs, Nev., for 25 years (1868 to 1893), having been laid on an "alkali flat" and preserved by the salts in the earth. Similar ties in ordinary soil last from six to eight years. There are also some ties treated by the chloride of zinc process at the works of T. Goldschmidt, Essen-on-Ruhr, Germany, which have been in service for 11 years on the Royal Prussian Government Railways, between Berlin and Wittenberg, and are in fair condition but slightly flange cut by the T-rails.

Metal ties make a good showing, especially in the foreign exhibits, as such ties are very extensively used in other countries, but only to a limited extent as yet in this country. Of American ties there are the Schoen pressed steel tie for the New York Central R. R., above described; the Standard steel tie, which is in use on the Chicago & Western Indiana R. R., and has been described and illustrated in our columns; and the Price steel tie, exhibited by the Price Railway Appliance Co., of Philadelphia, Pa. The Schoen tie may be favorably noted for its simplicity and its secure fastenings, and may be expected to give excellent results in service, although some doubt is expressed as to the advisability of so deeply bending the middle and ends. The Price tie consists of two angle irons with malleable iron brackets on top and spacing pieces or "anchors" below, these parts being riveted together. Wooden blocks between the brackets receive the rails, and each rail is secured by two vertical clamps held up by a horizontal bolt passing through the block and clamps. The tie weighs 100 lbs. and costs $3. It appears to be at a disadvantage in being composed of so many pieces, but as 500 were laid on the Philadelphia & Reading R. R. in April, the service test will bring out any weak points. Several modifications of these ties are shown. The American Track & Car Co. has a cross-tie of circular section with flattened top, the interior being filled with ballast and the rails being fastened by bolts. Besides these there are models of the Taylor ties, tried on the Chicago, Santa Fe & California R. R., and costing 80 cts. each; the Schofeld ties, of the Schofeld Co., weighing 50 lbs., and said to be used on the Lookout Mountain Ry., Chattanooga. Both of these are too light and cheap for proper economy in regular service. The Morrell tie, which closely resembles the Standard, is also exhibited by a model, and there are other designs of greater or less ingenuity of design, most of them entirely untried. The Pope tie is a steel trough with stamped lugs, and having a tieplate and clamp key fastening to each rail.

The foreign exhibits of metal ties show a strong evidence in favor of a simple steel crosstie of trough section, with bolted clamp fastenings. Some of these, including those used by the Prussian State Railways, Gothard Railway and London & Northwestern Railway, have already been described. The following particulars of others represented will give some idea of the extent of the use of metal track abroad, although the list is, of course, very far from approaching completeness:

Post's steel crosstie (Angelur works, Belgium); 165 lbs.; about 1,000,000 in use in Europe, Asia, Africa and South America.

Boyenval & Ponsard steel crosstie; 129.8 lbs.; $2.48; about 3,000 in use on state railways in France and Algeria.

Western Railway of France; steel channel with chairs for double-head rails cast around it; 297 lbs.; $3.

Decauville; flat plate with edges turned down; used on about 1,000 miles of light and portable railway in France, Spain and Portugal.

Heindl steel crosstie; 138.6 lbs.; $2.11; 375 miles on the Northwestern Railway of Austria.

Maclellan steel bowls with tie rods; 33 lbs. each bowl; $2.25 complete; used in India.

Denham-Olpherts cast iron plates with tie rods; 109 lbs., over 3,000,000 pairs used on the East Indian Ry.

Steel trough tie (similar to a heavier type extensively used in India) made by the Mossbay Co. for the Delagoa Bay & East Africa Ry.; 72 lbs.; 90 cts.; rails secured by keys driven between rail flange and lug on tie.

Cabry & Kinch steel crosstie, with lug and key fastenings; 150 lbs.; 10,000 on the Northeastern Railway, England.

There is also the Z-bar or Willemin steel tie, described by us in 1891, and manufactured by the Couillet Iron Works, Belgium, for the Congo Railway.

The Hohenegger steel longitudinal bearing system, used on the Austrian State Railways, is also exhibited.

Tieplates are numerous, including the Servis ordinary and combination plates (the latter with a lag screw and clamp fastening); the Goldie plate; the Churchward plate, with teeth on the under side; the McConway & Torley plate; the Wrenshall plate, with screw bolts through the ties for rail fastenings; and the Weir combined tieplate and rail brace. Most of these have been illustrated and described in Engineering News, but it may be noted that the tendency is to a plate having a rib to resist the outward thrust of the rail and so prevent the cutting of the neck of the spike and relieve the spike of the outward pressure. The foreign tieplates, apart from those used on some of the metal ties (already noted), include the Post plate, with screw spikes, as used on the Netherlands State Railways; and the Hohenegger plate with bolted clamps, of which 75,000 are used in Austria. The exhibits of American ties deeply cut by rails and crushed by spiking represent the present state of affairs on the average American railway track, and are no novelties to railway men. They serve, however, to add strength to the arguments in favor of the use of tieplates and improved fastenings in the interests of economy, efficiency and safety. The Southern Pacific Ry. tie is a case in point, as it shows a wood which will resist decay for over 20 years, but which will be cut out by the rails in six to eight years, necessitating renewal of a good tie, which might have been avoided by a small expenditure for protective plates. This point can hardly be too often or too strongly insisted upon.

American Track Material.

Rails.—Besides the rails in the completed tracks already referred to, there are numerous rail sections exhibited by the Pennsylvania Steel Co., the Cambria Steel Co. and other makers. A novelty in rails is the anti-creeping rail, exhibited by Howard Greer & Co. (makers of the Greer spike), which has square projections at intervals along the edges of the flange. This is a development of Col. Robt. L. Stevens' proposal about 1830, to roll rails with a varying width of flange. A patent for a similar purpose, but effected by notched or wavy edges to the flanges, has recently been granted to Mr. E. Patterson, of Titusville, Pa., who, however, has no exhibit. The old rail of bridge section is advocated as new and superior to the T-rail by J. H. Campbell, of Chicago, who calls it "the coming rail."

Rail Joints.—These are numerous, including a number of devices but little used. The Price Railway Appliance Co., of Philadelphia, Pa., exhibits the Price joints, illustrated and described in our columns, and also joints for high girder rails having four bolts in two rows. The joints are used extensively on the Lehigh Valley R. R. and Philadelphia & Reading R. R., and are to be tried on the Chicago & South Side Rapid Transit elevated railway. The Carlisle Mfg. Co., Carlisle, Pa., has a joint in which the rail ends rest in a shallow channel and are secured by splice bars having inclined outer surfaces, against which bear the inclined faces of four spikes on each side. Any loosening of the spikes, however, would at once make a loose joint. The rail joints exhibited by G. P. Rose, Fenton, Mich., have reinforced splice bars, thickened at the middle by offsets, or by taper and fastened by six bolts for square cut rail ends or five bolts for scarfed or beveled ends. There exists no good reason for beveling or scarfing, but the hinge principle of the five-bolt joint, already extensively used in India, makes this arrangement one of considerable promise if the joints are properly made. The Steever Rail Joint Co. has angle bars with a central projection extending below the rail and having two bolts below in addition to the four bolts through the rail. W. F. Gould, of Des Moines, Ia., shows a removable wearing piece between the rail head and angle bar, and has also a double-bevel joint. In fact, there are quite a number of joints showing scarfed or beveled rail ends. The Fisher Rail Joint Co. shows the Fisher, Otis and triple-fish joints, all of which have been described and illustrated in our columns. The Campbell joint, exhibited by J. H. Campbell, Chicago, has a bridge plate with stiffening web below; one end of the plate is riveted to the flange of one rail, and the opposite end has side lugs to hold the other rail; the splice bars are riveted to one rail and bolted to the other. Renewals or repairs could not be effected without considerable trouble, and the joint is one of a class in which practicability is given but scant consideration. Morris, Sellers & Co., of Chicago, have an exhibit of Samson bars, of which 10,640,360 are in use on 204 roads. The Trenton Iron Co., of Trenton, N. J., includes in its exhibit the Continuous rail joint, consisting of two angle bars united by a web which forms a bearing for the base of the rail ends. The joint shown by J. L. Pope, of Cleveland, O., dispenses with bolts and secures each angle bar by one wedge between the four and rail flange, and another between the side of a base plate and the outer faces of the rail flange and bottom wedge. The wedges are the full length of the angle bars and the base plate is somewhat shorter. The joint thus consists of seven pieces with long bearing surfaces and is said to have given satisfactory results in service. The outer wedges may be dispensed with. We shall illustrate this joint in a later issue. On the whole, there is nothing specially commendable in new joints, but the Pennsylvania R. R. arrangement of fastening the ordinary angle bars to the ties by lag screws is a step in the right direction for securing a firm hold of the rails to the ties and preventing the battering motion between rails and ties. We would suggest that the principle be carried further by using lag screws instead of the now insufficient spike on intermediate ties (as on the New South Wales track, above described), and also that a little more attention be paid to the rail fastenings, even at the expense of less attention to the joints.

Rail Fastenings.—One of the most novel and promising designs is one invented by Colonel Katte, of the New York Central R. R., and shown by the Schoen Mfg. Co., of Pittsburg. It consists of steel screw spikes driven at an angle inclining under the rail, and holding the rail flange by steel clamps of the form used on the New York Central R. R. steel ties, already referred to. The Bush Interlocking Bolt Co., of Philadelphia, exhibits its fastening, which is familiar to most of our readers, and the Howard Greer Co. and Morris, Sellers & Co., of Chicago, exhibit the Greer flat chisel-edge spike, which has been illustrated and described in our columns. The Goldie spike (Dilworth & Porter, Pittsburg) and the Ames spike (Ames & Co., Jersey City) are also shown. Apart from the screw spikes, and the lag screws of the Pennsylvania R. R. rail joints, however, there is but little to mark an improvement in this singularly weak point of American railway track. The foreign tracks have a substantial appearance, while the American tracks with 100-lb. rails "nailed" down by ordinary spikes, have by no means a good or serviceable appearance. The "improved" spikes with smooth surfaces and sharp edges are superior to the ordinary spikes, but are not sufficient for heavy track under heavy traffic. Mr. J. F. Le Baron, of Jacksonville, Fla., shows a jagged spike with split end fitted with a wedge; a hole is bored deeper than the spike, and when the spike is driven home the wedge is pressed up into it, spreading the side and driving the sharp barbs into the side of the hole.

The Greer company, above mentioned, exhibits oval necked track bolts with nuts having a round washer formed in one piece with the nut. The bolt exhibit of J. H. Sternbergh & Son, Pittsburg, Pa., shows the Harvey bolt with grip thread, sections of bolt and nut showing the thread before and after upsetting. These bolts are used for rail joints and steel tie fastenings by the New York Central R. R. The nut locks include the "American" (round washer with metal spirally twisted), by the American Nut Lock Co., of St. Louis; the

"Positive" (resembling a Verona with sharp points), by the Positive Lock Washer Co., of Newark, N. J.; the single and double "Excelsior" (too well known to need description here), by Ruffner & Son, Philadelphia, Pa.; the Young reversible (described in our columns), by the Young Reversible Lock Nut Co., of New York; the Jones nut lock, and the McCormick, by Mr. C. W. McCormick, of Emporia, Kan. This latter consists of a split sleeve and washer, with inside and outside thread; this is put on and screwed up, and the nut then run on the sleeve, clamping it upon the bolt.

Track tools are exhibited by the Verona Tool Works, of Pittsburg, Pa., including picks, clawbars, sledges, rail benders, etc. There are several makes of jacks, including those of Fairbanks, Morse & Co., Chicago, and A. O. Norton, of Boston. These latter are ball-bearing, ranging as high as 25 and 35 tons capacity, 50 tons being a maximum and used for bridge work. The track jacks weigh 70 lbs. and have a rise of 15 ins. The Drexel Railway Supply Co., of Chicago, and Schuttler Mfg. Co., of Chicago, show track drills; and the Drexel Railway Supply Co. and Tilden & Co., of Cleveland, show rerailing frogs, the Tilden frog being also applicable as a bridge guard, as already described in our columns.

Switches and Frogs.

In this department of track the greatest novelty is the Duggan switch, with vertically moving switch rails, which was illustrated and described in our issue of April 27, 1893. It forms a part of the exhibit of the Pennsylvania Steel Co., which company also exhibits standard designs of switches, three-throw switches, track crossings, spring and rigid frogs of different patterns, switch stands, electrically operated and interlocked semaphores and automatic electric bell signals for highway crossings. All of these represent everyday work, including some heavy construction, and are not novelties. The Carlisle Mfg. Co., of Carlisle, Pa., and the Cleveland Frog & Crossing Co., of Cleveland, O., also exhibit standard constructions of switches, switchstands, frogs and crossings, a specialty of the latter being the Lucas patent steel filled frog, with filling made of rolled steel. The Nowlin automatic safety switch (Nowlin Safety Switch & Signal Co., Chicago), is an example of misdirected ingenuity, since it is designed to be operated by the engineman while the train is running, the object being to prevent the common accident of running into open switches. Inclined planes with depressing rails are fitted alongside the track and are moved by a vertical arm on the engine or tender (or on the caboose) which can be raised or lowered by the engineman or brakeman. The device will also close a switch behind the train. It not only requires special appliances to be fitted to every engine, but puts an undesirable power in the hands of the trainmen. Safety from open switches will be effected by the gradual introduction of interlocking plant and by greater care in operation, rather than by allowing the engineman to act as his own switchman. The O. A. Switch Co., of Bradford, Pa., exhibits its distant switchstand for sidetrack switches. It is placed 300 ft. from the switch, to which it is connected by wires. A train wishing to take the sidetrack will slow down at the distant switchstand to enable the head brakeman to get down and open the switch in advance of the train, which need not stop but can run at about 8 or 10 miles per hour. The switch is locked from the distant stand. The rear brakeman gets off at the switch, unlocks it and sets it for the main track. The switch is operated independently from each stand and is locked by each, while the target at the switch (the distant stand has no target) will not show track clear until the switch rail is firmly home against the main rail.

Cattle Guards.

The modern type of surface cattle guard is represented by four different styles of this type, most of which have been illustrated and described in our columns. The National Surface Guard Co., of Chicago, has three guards, two with flat steel plates set on edge (parallel with the rails), the plates having "saw tooth" upper edges, and alternate plates being about 1 in. above the others. The plates are bolted to cross-pieces, and there are four sections to each crossing, two between and two outside the rails. It is said that 24,000 of these are in use on 270 railways in the United States, Canada and Australia. The same company also shows its No. 5 guard having A-shaped strips riveted to end pieces, and alternating in height. The Common-Sense guard, shown by the Bush Cattle Guard Co., of Kalamazoo, Mich., has small inverted T-irons on iron cross-pieces. The Merrill-Stevens Mfg. Co., of Niles, Mich., shows a guard with small T-irons set slantwise in transverse supporting pieces. The surface guard of the Kalamazoo Railway Velocipede & Car Co., Kalamazoo, Mich., consists of metal plates the full length of the crossing with high ridges formed lengthwise and triangular teeth stamped up from the flat portions between the ridges. All of these surface guards are in regular use, together with others not exhibited, and mark a decided improvement upon the old pit cattle guard or the surface guard with wooden strips nailed to the ties, these latter guards having generally two or three or more slats missing.

A HIGH AND LOW SERVICE STAND-PIPE AT ATLANTIC CITY, N. J.

Water-works were recently built for Atlantic Highlands, N. J., the supply being drawn from artesian wells. A high and a low service stand-pipe seeming advisable, the former for a very limited area, and only one site being available, it was decided by the engineer, Mr. C. Ph. Bassett, M. Am. Soc. C. E., to build a double stand-pipe. This structure is described by the resident engineer, of the works, Mr. A. P. Folwell, Jun. Am. Soc. C. E., in the "Journal of the New England Water-Works Association" for June, 1893, from which the accompanying illustrations have been redrawn. A half section of the structure is shown by Fig. 1 and its details by Fig. 2. Mr. Folwell's description of the stand-pipes, with some condensation, is as follows:

The low-service stand-pipe is 30 ft. in diameter and 35 ft. high, and has a capacity of 178,000 gallons. Resting upon the same foundation and imbedded in the concrete is a hollow cast iron pillar extending vertically through the center of the low-service tank to a height of 30 ft. above the foundation. This supports the high service tank, 15 ft. in diameter and 15 ft. high, having a capacity of 19,800 gallons; the upper 10 ft. of it is therefore elevated above the top of the lower tank. Spanning the space between the top of the lower tank and the side of the upper one is a continuous ring of sheet iron, the joints of its plates with each other and with the sides of both tanks being watertight under pressure. In the bottom of this upper tank is a flap valve opening upward. There is an overflow pipe with its funnel mouth a few inches below the top of the upper tank; and a ventilation pipe carried upward from the top plate of the lower tank to a point slightly above the top of the upper one gives free communication with the air and permits the emptying or filling of this tank independently of the other. From the pumps a 10-in. main leads into the lower tank, serving as both inlet and outlet for the low service. Parallel to this for a distance of at least 10 ft. from the tank, and connected with it by a 4-in. cross-over, is a 4-in. pipe leading up through the hollow cast iron pillar into the upper tank and serving as both inlet and outlet for the high service. Valves are placed in the cross-over, and in both the 4-in. and 10-in. mains between it and the stand-pipe.

Both tanks being empty, the valve in the 10-in. main will be opened and those in the 4-in. main cross-over closed. The pumps being started will then force the water through the 10-in main into the lower tank. When this has been filled to a depth of slightly more than 30 ft. the valve in the bottom of the upper tank will open automatically, admitting water into this tank which will in turn be filled to the level of the overflow, when pumping should stop. Meantime the valve in the 4-in. main having been opened, this and the connected service pipes will be filled and both high and low service ready for use. When the pressure from the pump is lowered the weight of water in the upper tank will close the valve, thus shutting off all connection between the high and low service, as the valve in the cross-over has remained closed.

When it is desired to fill the upper tank before filling the lower, or, in case of a fire in the high service district, the valve in the 10-in. main should be closed and that in the cross-over opened, when the pump will force directly into the high service main and tank. By closing the valves before referred to, either the 10-in. or 4-in. main, either tank can be cut off from the system and cleaned or repaired.

A firm natural foundation of compact sand and gravel is found at the site of the stand-pipe. The artificial foundation consists of concrete thoroughly rammed in layers of 6 ins., 36 ft. in diameter and 4 ft. deep, 3½ ins. being below and 6 ins. above the surface. Concrete is thoroughly packed around the inlet, outlet and overflow pipes, and placed to a depth of 5½ ft. where the pipes occur and 6 ins. wider than the external diameter of the flanges or hubs of the pipes. That part of the foundation under the bedplate of the central column is of Portland cement concrete. The concrete is composed of one, two and three parts of cement, sand and broken stone, respectively.

A manhole, 18 × 24 ins., is built in a lower sheet of the bottom stand-pipe. All wrought iron is tough, fibrous and of uniform quality; that for plates and angles showing a minimum ultimate tensile strength of 48,000 lbs. per sq. in.

Supporting the top plate of the lower stand-pipe, which acts as the floor of the observatory, are two sets of braces inside the tank, numbering 34 in all. A railing above the sides of this stand-pipe surrounds the observatory.

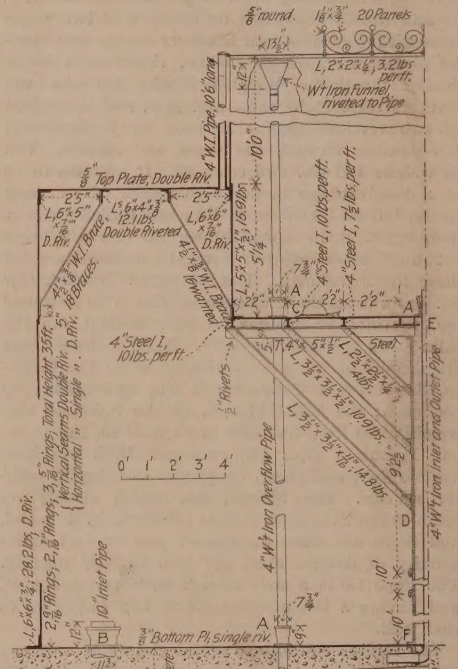


Fig. 1. Combined High and Low Service Stand-Pipe; Atlantic City, N. J.

One foot below the top surface of the foundation, in the center of the stand-pipe, is set a cast iron footplate 4 ft. square (Detail F, Fig. 2) which sustains the weight of the upper tank. The load upon the concrete transmitted by this footplate when the upper tank is full would, therefore, be about 80 lbs. per sq. in. Bolted to and resting upon this footplate is a hollow cast iron pillar (Details D and E, Fig. 2), 1 ft. interior diameter and 1 in. thick, rising vertically to a height of about 30 ft. above the foundation. Cast on this are three rows of lugs, eight lugs in each row around the pillar, to which are riveted 24 angle iron braces serving to support the beams upon which the top tank rests. These beams are 5-in. steel tees, eight in number, radiating from the cast iron pillar upon which they rest, and connected by a circular wrought iron plate to which they are riveted. Resting upon these beams and forming the immediate support for the upper tank are 4-in. steel I-beams spanning the spaces between the T-beams and arranged as chords of three concentric circles. The upper tank has a bottom of ½-in. and sides of ¼-in. iron, is 15 ft. high and surrounded by wrought iron fretwork. Riveted to the bottom is a flap valve (Detail C, Fig. 2) acting upward, the circular orifice having a diameter of 10 ins. A 4-in. overflow pipe which leads to the sewer extends through the bottoms of both tanks, and is topped by a funnel whose mouth is 13½ ins. in diameter and 6 ins. below the top of the upper tank. Where this and all other pipes pierce the bottom of either tank a water-tight connection is made by means of a cast iron flange surrounding the pipe, riveted to the bottom plate and calked with lead around the pipe (Details A and B, Fig. 2).

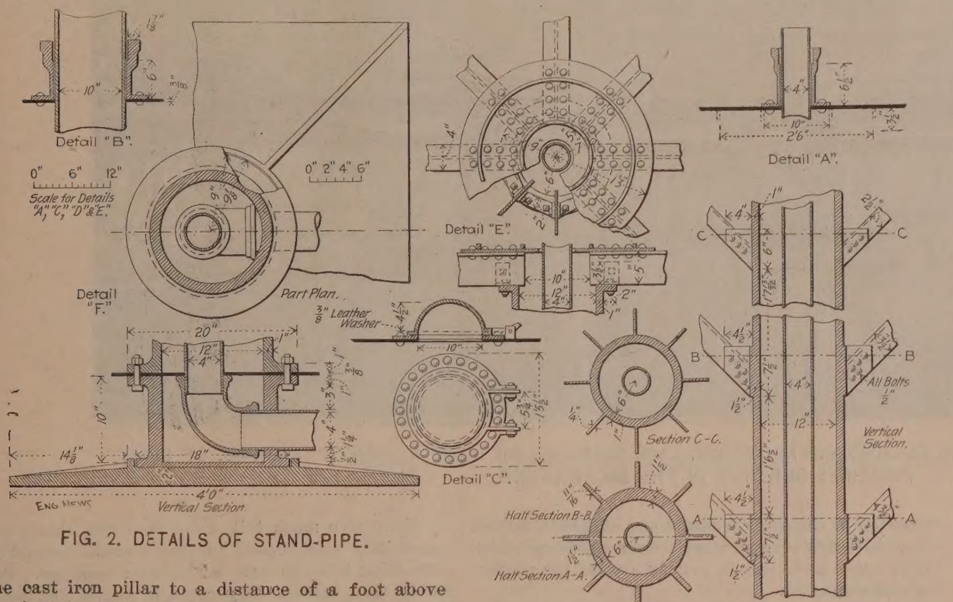


FIG. 2. DETAILS OF STAND-PIPE.

The 4-in. inlet pipe for the upper tank is laid through the concrete foundation and rises inside the cast iron pillar to a distance of a foot above the bottom of the tank. This serves also as the outlet pipe. A 4-in. pipe pierces the top plate of the lower tank and rises to a few inches above the top of the upper tank. This allows for escape and admission of air as the water rises or falls in the lower tank. The 10-in. pumping main, rising a foot above the bottom of the lower tank, also serves as both inlet and outlet pipe.

As the stand-pipe is placed at one side of the borough, while the pump is near the center, and as the pumping main also serves as a distribution main, this is practically a direct pumping system. The entire lift of the pumps from the wells to the top of the stand-pipe is 300 ft. Calculation is made on a basis of a present daily consumption of 750,000 gallons; but provision is made for duplicating the pumping plant in the future.

An area of ground adjacent to the stand-pipe is held sufficient for a reservoir should this at some time be needed; in which case the pumping main would lead directly into the reservoir, and a branch from this main connect with the stand-pipe.

A CONCRETE LINED CONDUIT IN SAND.

A paper presented to the Michigan Engineering Society by Mr. A. L. Reed describes the development of the El Monte Basin, in the Upper San Gabriel Valley, Los Angeles Co., Cal., for irrigation purposes. The most interesting feature is the construction of the distributing conduit here described.

The fall of the river bed in the basin is from 20 to 30 ft. per mile, and this bed is made up almost entirely of dry sand and gravel with benches on either side, a few feet higher, of similar material. Water was secured by putting down 12 artesian wells, from 80 to 200 ft. deep in sand, and by sinking a 4 × 6-ft. wooden flume, parallel to the river bed and about half a mile long, with coarse gravel in the bottom. By these means about 400 miners' inches of water was secured, and the projectors were warranted in constructing a distributing main or conduit.

It was decided to use a conduit with a capacity of 1,500 ins., or 30 cu. ft. per second, on a grade of 1 in 4,000. This conduit was built with Portland cement concrete sides and bottom of the following dimensions: Net bottom width, 4 ft.; top, 6 ft. wide with the top 8 ins. vertical; depth, 3 ft. 4 ins. The 6,000 lin. ft. of wooden flumes were 4 ft 6½ ins. wide and 3 ft. 4 ins. deep. The excavation for the conduit was in a fine, soft sand and the entire work was in excavation, except where trestling was necessary; and all embankment was avoided for fear of settling and washing. The excavation in the sand was made by hand after the material had been loosened by plows with horses used tandem. The exact outside dimensions of the cut were ascertained by a template and the men soon became very expert in this cutting.

The concrete was made of 1 part Portland cement to 10 parts of a naturally mixed sand and gravel used without screening. The larger part of this concrete, however, was made one to eight. On the bottom and sides of the conduit the concrete was 2½ ins. thick; the corners were reinforced and the upper 8 ins. were vertical, as before mentioned. In placing the concrete a form was used made of 2 × 3-in. pine pieces 20 ft. long, connected by 1 × 4-in. strips and well braced. These forms were easily placed in the prepared excavation by two men, and after being adjusted they were held in place by iron pins driven into the bottom. For the sides 1 × 12-in. boards were used placed in one at a time as the concrete was rammed and packed behind them in 6-in. courses. Three 12-in. boards thus placed formed the mold for each side, and two 8-in. boards placed vertically at the top completed the form. Behind the 8-in. strips their wedges were placed, and when the concrete had sufficiently set these wedges were released and the 8-in. boards lifted out; then, the entire frame was lifted and carried to the next section and the 12-in. lagging boards were easily taken up.

As the alinement was very crooked in places, it was impossible to exactly adjust adjoining forms. To obviate this difficulty strips of sheet iron were used at the joints, fitted behind the ends of the adjacent lagging. The concrete was mixed on platforms from 300 to 400 ft. apart and shoveled into a low hopper car which was run to the point of delivery on a portable wooden track laid in sections on the upper crosspieces of the forms.

As soon as the concrete had fairly set and the frames were removed the rough places were smoothed up with fine mortar and a trowel. After this man came a bottoming force which spread the concrete evenly over the bottom and rolled it with a heavy hand roller. Finally, the inside of the conduit was given a heavy coating of a neat cement wash of the consistency of thick cream laid on with a whitewash brush. This last coating filled the pores of the concrete and made the conduit smooth and water-tight.

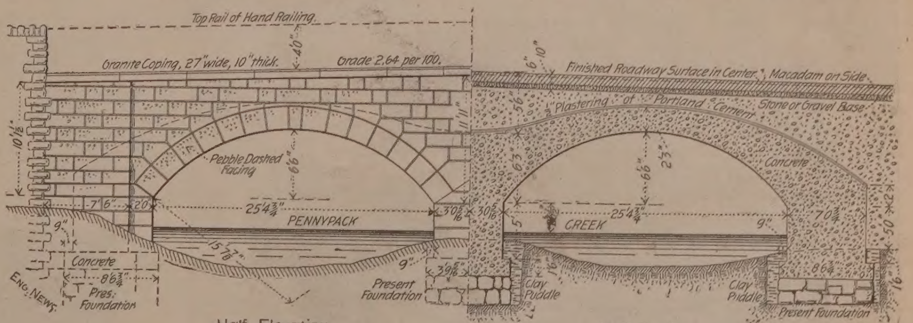
This concrete conduit was covered over its entire length with redwood plank from 2 to 4 ins. thick spiked to three longitudinal strips of 2 × 3-in. stuff with the outside strips pressed firmly against the 8-in. vertical walls. Except in the villages and in special places, these planks were not covered with earth but were cleaned of all dirt and rubbish every season. This conduit has done good service for over two years.

The secret of success in this conduit lay in cutting the trench very carefully to size and in not disturbing the naturally packed sand. In the discussion which followed the reading of Mr. Reed's paper Mr. John Randall said that he had built a reservoir by simply plastering 1½ ins. of cement mortar (one cement to five sand) directly on the sand, cutting the sand away with a trowel down to the undisturbed soil, and putting on one layer of cement while the sand was yet moist. This structure has held the water for four years against a head of 16 ft. without leaks.

CONCRETE ARCH HIGHWAY BRIDGE, PHILADELPHIA, PA.

While the use of concrete arches for bridges is quite common in European countries, we illustrate in the accompanying cut what is, so far as we now recall, the first concrete arch bridge ever put under construction in the United States. This bridge is being constructed to carry Pine Road over Pennypack Creek, in the city of Philadelphia, Pa., and was designed by Mr. C. A. Frik, Superintendent of Bridges. To Mr. Frik is also due the credit of inducing the city authorities to give the use of concrete for bridge structures a trial in this bridge.

The bridge consists of two arched spans of 25 ft. 4¾ ins., with a rise of 6 ft. 6 ins., supported by concrete abutments and a concrete pier, and is built on a slight skew. It is 34 ft. 3¾ ins. wide out to out of parapets and carries a 26-ft. macadam roadway, with two granite-paved gutters 2 ft. wide on each side. The arches proper are 2 ft. 3 ins. deep at the crown, and are covered on top with a ½-in. layer of Portland cement. The spandrel filling consists of compactly rammed concrete. The spandrel walls and faces of the arches are molded to represent ashlar masonry and are afterward pebble-dashed to show a rough surface.



CONCRETE ARCH HIGHWAY BRIDGE; PHILADELPHIA, PA.

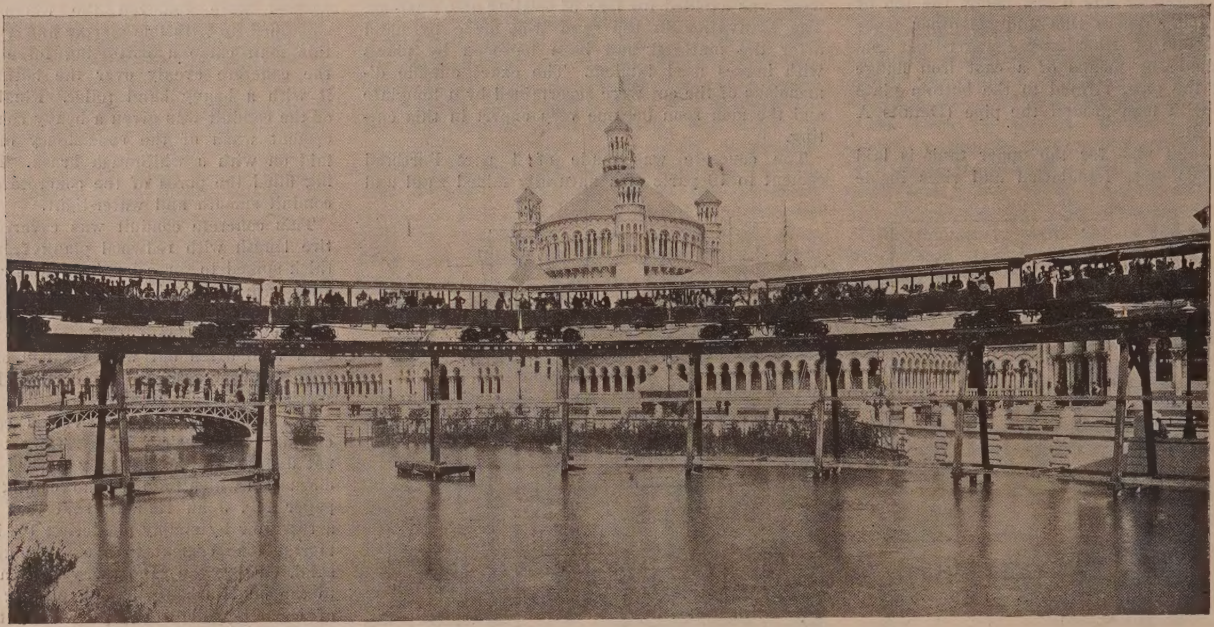
For the foundations Dykerhoff's Portland cement is used, and for the abutments, piers and arches Manheimer Portland cement. To strengthen the work 1½-in. mesh wire nets have been placed about 2 ft. apart, horizontally and vertically, throughout the concrete. The diameter of the wire in this netting is ¼ in. The roadway consists of 16 ins. of macadam. The total cost of the bridge is estimated as follows:

Concrete bridge, 680 cu. yds., at $9.30	$6,324
Appurtenances, macadam, etc.	2,338
Total cost	$8,662

Among the other concrete bridges described in recent issues of Engineering News are the viaduct for the Jamaica Government Ry., in Jamaica, in the issue of July 27, and the several arches of the Monier type in the issues of May 23, 1891, Nov. 10, 1892, and Feb. 16, 1893.

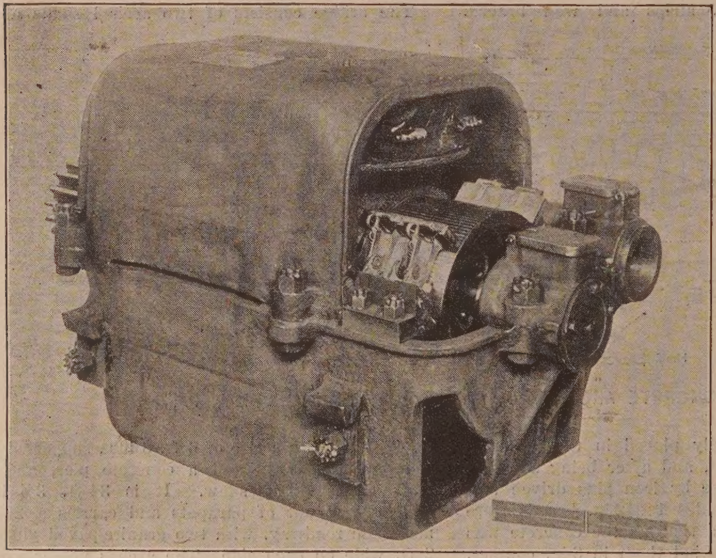
VIEWS ON THE INTRAMURAL ELEVATED ELECTRIC RAILWAY AT THE COLUMBIAN EXPOSITION.

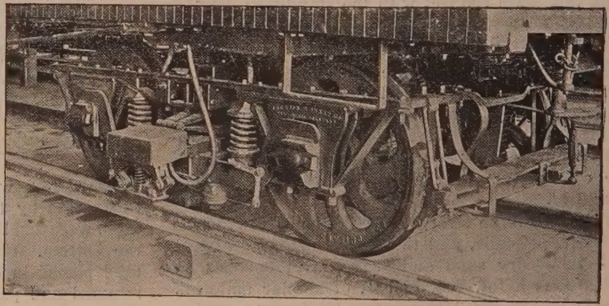
We have already made our readers familiar by descriptions and working drawings* with the features of principal interest in connection with the elevated railway at the World's Fair, and we show herewith a number of engravings reproduced from photographs taken on various parts of the line.


THE INTRAMURAL RAILWAY AT THE COLUMBIAN EXPOSITION, CARS STANDING ON LOOP AT NORTH TERMINAL OF LINE, FISHERIES BUILDING IN THE BACKGROUND.

In the first engraving a train is seen standing on the terminal loop which crosses the lagoon just north of the Government Building. The beautiful Fisheries Building, one of the architectural gems of the Fair, is seen in the background. This curve and that at the other terminus are of 100 ft. radius, and there are several other curves as sharp which were made necessary in getting around the corners of buildings, etc.

As we have before stated, the electric current for operating the railway is generated at a power station near the southern terminus and is transmitted along the line by four steel rails of about 60-lb. section, which are laid between the tracks. The motor car takes current from the rail nearest the track by a sliding collector and the two inner rails serve as feeders for the other two. These current-carrying rails are raised about 12 ins. above the level of the track rails by blocks of creosoted wood, which serve also as insulators. Unlike the ordinary electric road, no part of the return circuit on this line is through the ground. The track rails with the iron girders of the structure serve as return conductors. As the posts supporting the elevated structure are of wood, there is little chance for leakage to the ground. Our engraving shows a truck of one of the motor cars with the sliding current collector attached. This is the most extensive trial which has ever been made of sliding current collectors in this country and the results, we understand, have been very satisfactory.


ELECTRIC MOTOR USED ON INTRAMURAL CAR.


TRUCK OF AN INTRAMURAL CAR, SHOWING CURRENT COLLECTING DEVICE.

There was much talk some time ago, that when electricity was applied to long trains it would be the thing to do to have a motor on each car. Possibly that fashion may come in vogue yet, when very long trains are propelled by electricity; but at present experience favors concentrating the traction at the head of the train. The motor cars on the Intramural R. R. are like the other cars, save that they are equipped with a motor on each axle. We have ridden on this motor car when it had a fully loaded train of five cars behind it and could discern no slipping of the wheels although the train was got under headway much more rapidly than in ordinary elevated railway service. The uniform turning moment of the electric motor is a factor of much importance in preventing slipping of wheels.

Another of our illustrations shows one of the motors used on these cars. It is a single-reduction four-pole motor and can develop about 133 HP. and propel the train at a speed of 30 miles per hour. A load of 50 HP. per motor, however, is ample to propel the train at this speed, we believe.

The motors are controlled by a "series-parallel" controller operated by a compressed-air mechanism. When the car is started the four motors are in series, then two are in series and two are short circuited; then the four are in series of two pairs of motors, each in multiple; then two are in multiple and two are short circuited and finally all are in multiple. By this method the trains are started smoothly and the speed is imperceptibly increased.

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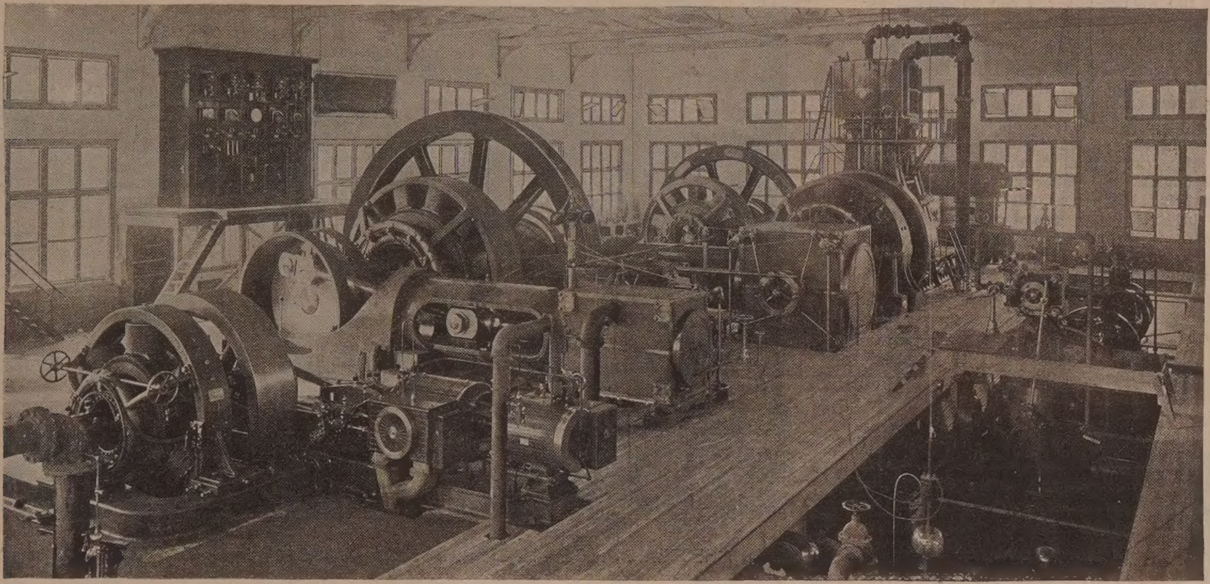
*For map of the line and description of superstructure track and stations, by C. P. Matlack, Chief Engineer, see Engineering News, Oct. 13 and 20, 1892. For drawings and description of the power house and its equipment see April 6, 1893. The cars were shown in the issue of June 8.

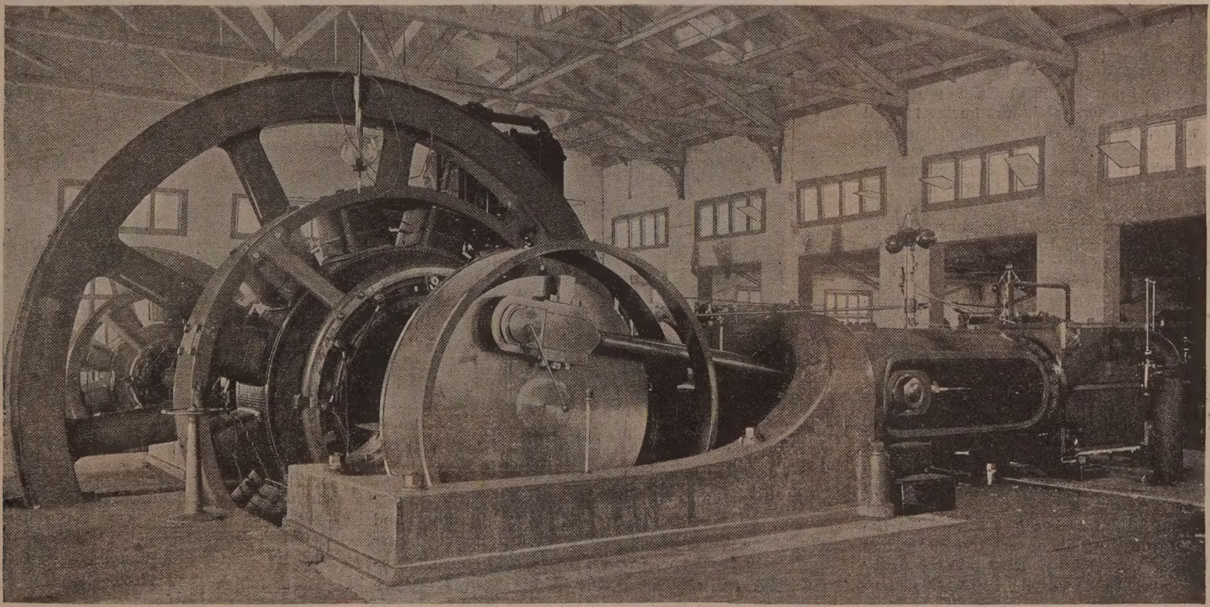
Our fourth illustration is from a photograph in the interior of the power-house. The small engine in the foreground is a McIntosh & Seymour tandem-compound, coupled direct to a 200-K.-W. generator. Behind it is the big engine of the station, a 2,000-HP. cross-compound Reynolds-Corliss from the E. P. Allis Co., having a 1,500-K.-W. generator mounted on its main shaft. This is not only the largest dynamo in the Exposition, but the General Electric Co. state that it is the largest ever built. While its rated output is 1,500 K.-W., or about 2,100 electrical horse power, it will stand an overload up to 3,000 HP. in an emergency. The total weight of the dynamo is 181,000 lbs., of which no less than 73,600 lbs. is in the revolving armature, 10 ft. 6 ins. in diameter and 3 ft. 3¼ ins. broad. The shaft on which it and the engine flywheel are mounted is 2 ft. in diameter, and with the flywheel hub weighs 56 tons.



ENGINES AND GENERATORS IN INTRAMURAL RAILWAY POWER STATION.

The flywheel rim is 24 ft. in diameter and its cross-section is a little less than 2 ft. square. Thus, its weight is not far short of that of one of the four-car trains run on the road; and as the rim velocity with the engine making 80 revolutions is about 6,000 ft. per minute, the energy stored in this revolving rim alone is about equal to that required to accelerate four of the trains run on the road from a full stop to a speed of 30 miles per hour.

Our last illustration is from a photograph of this engine and generator. It may be interesting to note that the armature of the generator is built up of 17,200 pieces of sheet iron, with a total weight of 25 tons. The massive construction of the whole machine is well shown by the engraving.



2,000-HP. REYNOLDS-CORLISS CROSS-COMPOUND ENGINE DRIVING 1,500 K.-W. GENERATOR IN INTRAMURAL RAILWAY. POWER STATION.

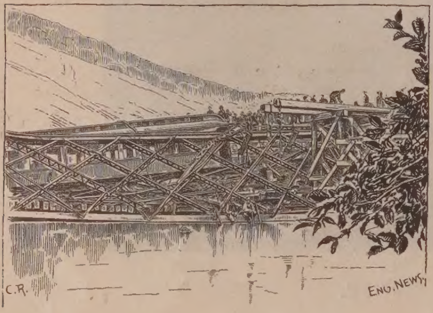
Referring to our general view of the power-house again, the vertical engine seen on the right of the big Allis machine is a 1,250-HP. compound, built by the Lake Erie Engineering Co. and directly connected to a 750-K.-W. generator. This engine has made a splendid record for itself in the station by handling the entire traffic of the road for weeks at a time without giving the least trouble. Even on July 4, when the heaviest traffic thus far experienced was carried, this engine handled the 14 four-car trains alone, working at times under a load of 1,775 HP., or 42% in excess of its rated capacity. The small space occupied by this engine is another good point in its favor. With the generator it occupies a space 13 × 24 ft., and it stands 21 ft. 8 ins. high. The engine whose flywheel and attached generator are seen on the left of the vertical Lake Erie engine in the general view is a Reynolds-Corliss tandem compound of about 750 HP. At the opposite end of the room, outside the field of view, is a Greene tandem compound of 750 HP. belted to a 500-K.-W. dynamo. It will be noticed that this is the only engine in the station which does not follow the modern practice of mounting the dynamo on the engine shaft.

From the above description it will be seen that the capacity of the power station is nearly four times the maximum demand for power by the road. It must not be understood by this that any such excess of engine and dynamo equipment is necessary or desirable in actual service. Both the engines and dynamos were installed as exhibits without regard to the actual requirements for power by the road, although as that was an experiment in an unprecedented field, it was deemed best to have sufficient power for use in any possible emergency. The small amount of power actually required for hauling the trains has been a surprise even to the designers of the station, and gives much encouragement to those who look to see electricity generally used in elevated railway traffic.

THE CHESTER BRIDGE DISASTER.

The most serious bridge accident which has been recorded for a long time occurred on Aug. 31 near Chester, Mass., on the Western division of the Boston & Albany R. R. The cause of the accident is, briefly, carelessness in the manner of repairing the bridge, work on which was in progress at the time of the accident. A letter from a valued correspondent of this journal who was early on the scene of the disaster gives the following account of the wreck:

Sir: I send by this mail some news which may be of interest to you of the wreck of train 16 of the Boston & Albany R. R. on Aug. 31, which went through a bridge over the Westfield River a mile or so east of Chester. The train was a through vestibuled train from Chicago, consisting of engine, baggage car, buffet car, two sleeping cars, dining car and three day coaches. The engine and tender crossed the bridge and turned on their sides in the ditch about 40 ft. from the end of bridge, being completely dismantled. The Wagner cars, buffet, dining and baggage cars fell through into the river, as shown in the views, some of them being completely broken up. The first day coach was left with one end broken in and hanging over the abutment; the other two coaches were left on the track practically uninjured. After looking at the wreck I was surprised that the loss of life was not greater than it was.



Part of the Wrecked Bridge Truss.

The bridge consisted of two spans, each about 110 ft. long—through riveted trusses built on a skew, with a light curve beginning either on or near the east end of the bridge. The train was eastbound, and was said to be going at about 20 miles an hour, and I should judge from the appearance of the wreck that it was going at least that fast.

The bridge was undergoing repairs, and from what I have been able to learn from questioning and inspection I should judge that it had been too much weakened by removal of rivets in the top chord preparatory to putting on additional plates; and that thus the plates had been permitted to act separately and buckle instead of acting as a whole. I should say that the south truss (the one nearest the track on which the train was) of the west span broke first, but held long enough to permit the passage of the engine, tender and just enough of the first car to strike the end of the truss of the second span in its descent. At the time of complete collapse the coupling had probably broken between the tender and the train, permitting the engine and tender to shoot forward and clear the bridge just as the second span went down sufficiently to distort the track and derail the engine. My reasons for this conclusion are the general appearance of the wreck and track and the fact that there was very little wreckage east of the pier.

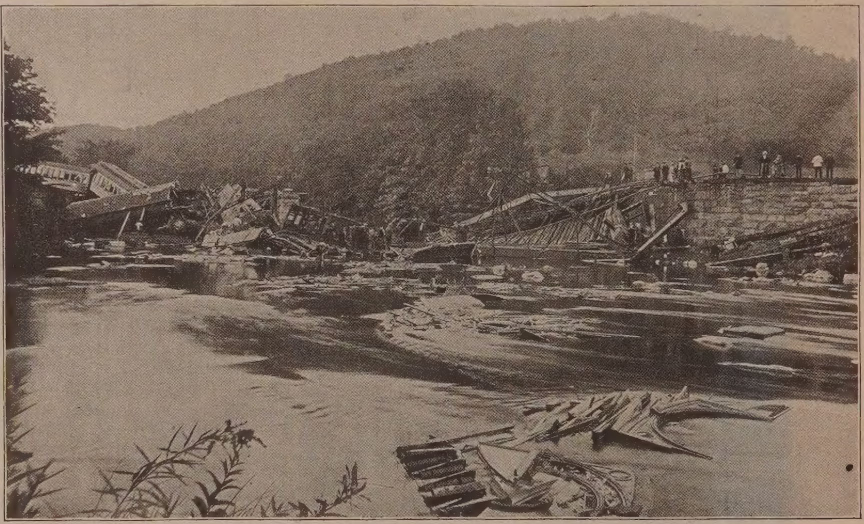
There was a statement quite prominently brought forward that the engine had left the track just before entering the bridge, but I think it hardly warranted by facts, as there were no wheel marks on the ties about 20 ft. from the end of the bridge. and the ties of the bridge floor (where left) were hardly enough marked to confirm this theory.

In this connection I think it but just to mention the "grit" of the fireman, Mitchell, of the train. He had three ribs broken, but immediately went into the water and worked for five hours assisting in the removal of killed and wounded before he could be induced to leave and take care of himself. Respectfully,

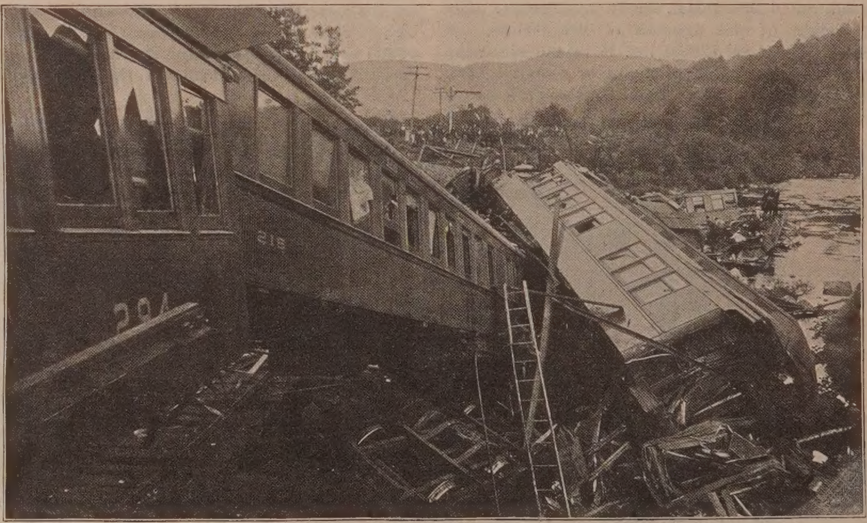
Walter Watson.

Pittsfield, Mass., Sept. 2, 1893.

Additional particulars of the disaster gleaned from press reports are as follows: The accident resulted in the death of 17 persons, and 32 were seriously injured. The bridge was built by the Niagara Bridge Works, in 1874. It was a double-track through riveted lattice structure with 11 panels about 9 ft. 8 ins. long. It was a quadruple system lattice, as shown in the accompanying sketch. It has been strengthened from time to time to meet the requirements of heavier rolling stock. At present the Boston & Albany intends to put some heavier locomotives on its Western division and is strengthening its bridges wherever necessary. This work is being done under contract by the R. F. Hawkins Iron Works, of Springfield. The gang at work on the Chester bridge consisted of four men under a foreman named J. B. Reed. Reed is about 40 years of age and was at one time with the Rochester Bridge Co. He has been a foreman for Hawkins for 15 years past. According to an interview with him published in the "Boston Herald," the rivets had been cut off on the top chord of one span for a distance of 10 ft., and the additional plates had been put on but not riveted, when 12 o'clock came and the men quit for dinner. Reed had left the work a half hour or more before, and apparently no one among the gang of men had any idea that they had dangerously weakened the structure by removing the rivets from some 10 ft. of the top chord. Fortunately, railway accidents in Massachusetts are investigated as they are in no other state; and the entire facts with relation to the disaster will doubtless be brought out in the Railroad Commission's inquiry.



THE CHESTER BRIDGE DISASTER, BOSTON & ALBANY R. R., GENERAL VIEW OF WRECK.



THE CHESTER BRIDGE DISASTER, LOOKING EAST FROM NEAR WEST ABUTMENT.

A NEW WATER-WORKS ASSOCIATION.

Some time ago we noted the formation of the Northwestern Water-Works Association. The membership of this body is largely made up of water-works men in the State of Washington, and all its present officials live in that state, but we do not understand that persons living in other states of the West are excluded.

The new association proposes to publish semi-annually papers prepared by its members, and recently brought out as its first number the proceedings of its first annual meeting, held at Seattle, Wash., in March last. This number included creditable papers, as follows: "A Descriptive History of the Growth of the Water-Works of Seattle," by Mr. W. E. Wilson, Superintendent of the works of that city; "Wood Stone Pipe," by Mr. A. L. McHawks, Tacoma; "Forms and Records Used in the Operation of Water-Works," by Mr. Chas. B. Hurley, General Superintendent of the Tacoma Light & Water Co.; "Water Rates," by Mr. W. F. Newell, Superintendent of the water-works of Olympia, Wash.

Mr. Chas. B. Hurley, of Tacoma, is now President of the association, Mr. W. G. Goston, also of Tacoma, is Secretary, and Mr. Miles C. Moore, of Walla, is senior editor.

TORNADOES.*

By H. A. Hazen, U. S. Weather Bureau.

Perhaps the most persistent phenomena in connection with tornadoes are the constant and profuse discharges of lightning which immediately precede or accompany them. Balls of fire or globular lightning have also been noted often. Tornadoes are very narrow, seldom over 500 ft., and always move from a westerly to an easterly point. There is a loud and indescribable roar which precedes them, and this may be heard 15 minutes before the tornado strikes, and will generally give sufficient warning. This roar is probably due to a constant thunder and has been heard in a modified way in connection with a severe thunderstorm. The paths are parallel, and distinct tornadoes move along these paths, beginning after the hottest part of the day. Each tornado has a path a little to the southeast of the former. This action may be kept up till after sunset or five or six hours after the hottest part of the day.

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*Condensed from a paper read at the World's Congress of Meteorology.

Little careful attention has been paid to the observation repeatedly made that the first appearance is of two clouds, one coming from the northwest and the other from the southwest. This appearance has been greatly misinterpreted at times, as it has been thought that the north cloud, which is cold, has met the warm south cloud. This has given rise to enormous contrasts of temperature, and the terrible conflict between these has developed or resulted in the tornado. It is evident that the meeting of two clouds of different temperature could not produce an unstable equilibrium at all; moreover, the appearance of these clouds all along the line show that they are engaged in a continuous action and do not form a single union, and thereafter move on as a storm. The distribution of debris also shows this clearly. In the center of the track all material, trees, etc., are deposited in parallel lines and look as though dropped by a mighty river flowing over the ground. On the south side there is an inclination inward and forward along the line of the storm. On the north side there is a similar action, but oftentimes the trees and debris are deposited in lines pointing to the direction from which the storm has come, showing that in such cases the north cloud acted first.

The most interesting point which now has come to the front is regarding the occurrence of an enormous whirl, with a diameter equal to the width of the greatest destruction. It has been thought impossible to account for the terrible destruction on any other theory. It is conceded at once that the onward progress of the tornado at 40 or 50 miles per hour could not do serious damage, but if the cloud rotates at 300 or 400 miles per hour all the destruction could be easily explained. Unfortunately this supposition, when properly examined, shows its own weakness. If a funnel whirling at 300 miles per hour should move at the rate of 40 miles per hour, then on the north side the velocity toward the rear would be 260 miles an hour, and in front it would be 300 miles per hour. No such action as this has ever been noted. It is safe to say that there is no such uniformity in the destruction or disposition of debris. This point regarding the whirl of the tornado is the one over which there is the greatest controversy at the present day, and demands the most careful investigation, especially in the line of a study of the debris. The strongest proof of the whirl has been the appearance of the cloud in midair, but a little thought shows that this appearance is most illusory and cannot be accepted in the light of the almost universal records of the distribution of debris.

PERSONALS.

Mr. W. E. Williams has opened an office in the Monadnock Block, Chicago, as a patent attorney and mechanical engineer.

Messrs. Berthoud and Moses, Civil and Mechanical Engineers, of Philadelphia, have dissolved partnership by mutual consent and the business will hereafter be carried on by Mr. Emile E. Berthoud under his own name.

Mr. Cornelius Shields, who has been for 15 months past General Superintendent of the Western division of the Great Northern Ry., has returned to the Chicago Great Western Ry. as General Superintendent, which position he held for three years before going to the Great Northern.

Mr. A. M. Morey has resigned his position as Superintendent of the St. Joseph & Grand Island R. R., on account of ill health, and Mr. C. W. Card, of Aurora, Ill., formerly trainmaster of the Chicago division of the Chicago, Burlington & Quincy system, has been appointed to succeed him.

Mr. Harry C. Ives, assistant to First Vice-President Robinson, of the Atchison, Topeka & Santa Fe, was killed in the bridge accident on the Boston & Albany R. R., on Aug. 31. He had been engaged in railway work since 1871, and had been connected with the Northern Pacific, the Missouri Pacific, Minneapolis & St. Louis, Great Northern and Atchison companies. The Great Northern was the company with which he was longest connected.

Messrs. H. J. Simmons and Charles Corner have been appointed by the Texas Railroad Commission engineering experts to their board, of which Hon. J. H. Reagan is Chairman. Mr. Simmons is from the Huntsville & Monte Sano Railway of Alabama and the Texas Central. Mr. Corner was formerly Principal Assistant Engineer French Railways of Venezuela, 1889, and Division Engineer Interoceanic & Mexican Southern Railways of Mexico, 1890-92.

NEW PUBLICATIONS.

SEPTEMBER MAGAZINES.—In the "Popular Science Monthly" Ernest Hart, President of the British Health Society, tells of the part which Mohammedan pilgrimages to Mecca play in spreading cholera from Asia to Europe and describes the constant soil and water pollution which is practised in India, and which keeps the cholera germs ever alive there. In 1887 the deaths in India from cholera numbered 488,000. The "California Illustrated Magazine" has an illustrated description of the remarkable fossil footprints found near Carson City, Nevada, in the State Prison quarry. Tracks made apparently by a sandaled human foot are found in conjunction with those of many wild animals; and the entire skeleton of a mastodon has been unearthed. Some authorities claim that the supposed human footprints were actually made by some extinct quadruped. In "Scribner's" Fred. J. Miller, M. Am. Soc. M. E., Associate Editor of the "American Machinist," writes the fifth article in the series on men's occupations, describing the work of the machinist, and gives much space to the precision of measurement which is attained in modern shop practice. Gustav Kobbe tells of the wonderful tides in the Bay of Fundy, which at Moncton attain a height of 70 ft. Among the illustrations accompanying this article are some excellent ones of the suspension and cantilever bridges at St. John.

"Harper's" has an article on "The Diplomacy and Law of the Isthmian Canals," by Sidney Webster, giving a statement of the laws, treaties and franchises under which each of the Atlantic-Pacific canal enterprises has been carried on. The author's conclusion is that the United States should rather hinder than help any Isthmian canal scheme, because of the disadvantages to this country in time of war which he thinks (unlike most authorities) would result from its construction. It is doubtful whether such reasoning could have any influence in hindering the United States from taking part in the building of a canal. An Isthmian canal will be a labor-saving machine for the whole world, and opposition for purely military reasons, which may or may not be found correct, does not seem likely to be much of an obstacle to its success. The more important point of the author's paper is his statement that the franchise of the present canal company rests on too insecure a basis to warrant investors from embarking in the enterprise. There is also a good paper on Prof. E. E. Barnard, of the Lick Observatory, the famous discoverer of comets. "The Review of Reviews" has a very good and well illustrated paper on "Engineer Ferris and His Wheel," written in a newspaper reporter style, it is true, but interesting even to the technical reader. In "The Century" we find a brief description of the principal South African gold fields, and an interesting account of the new national forest reserves established during the last administration. In the "North American Review" Gen. A. W. Greely writes on "Polar Possibilities of 1894." He considers the sea expedition of Dr. Nansen to be a reckless and foolhardy enterprise. Lieutenant Peary he commends for his bravery and pluck, but holds that he has not more than one chance in ten of going farther north than the latitude reached by Lockwood in 1882 and mapping out the northwestern boundaries of the archipelago discovered by him. The English expedition to Franz Josef land he thinks has good prospects of reaching a high latitude, and of adding something to our knowledge of that unexplored region.

ARITHMETIC OF MAGNETISM AND ELECTRICITY. By John P. Morrow, M. E., and Thorborn Reid, M. E., Assoc. Members Am. Inst. Elec. E. Lynn, Bubier Pub. Co., cloth, pp. 145. $1.00.

We believe this book will be found exceedingly useful to a large number of engineers, who, while they have neither time nor opportunity to make a thorough study of electricity, yet are finding it more and more necessary to make computations involving the use of electrical quantities, in carrying out some part of their designs. There are plenty of books which teach the physics of electricity; but we recall only one other book which attempts to make plain arithmetic of the art so that an engineer can familiarize himself with some of the simpler calculations at least, which he is beginning to feel ashamed not to know how to make. We do not mean by this that the book is one which will be of any service to the man who is wholly ignorant of electrical applications; it is intended rather for the man who has a little knowledge or perhaps a good deal, and wants more for practical use. While the general plan of the work appears to us most commendable, we wish it had been simplified still more and made easier of comprehension by the omission of various synonyms which appear to have been introduced in electrical science without good reason. For instance, why not say "flow," in plain Anglo-Saxon, instead of "flux." "Turning moment," which is familiar to every engineer, is better than "torque." The "C. G. S." units might have been omitted in a book intended for practical work, such as we understand this to be, and the space could then have been spared for fuller statements of the numerical relation between the electrical units and those in common use in mechanical engineering.

STEAMSHIPS AND THEIR MACHINERY. From First to Last. By J. W. C. Haldane, Civil and Mechanical and Consulting Engineer: London: E. & F. N. Spon. 8vo; cloth; pp. 532; $6.

The author of this volume has had an extended experience in the principal English shipbuilding works, and is well qualified to write on the subject he has chosen. As in his previous work, "Engineering Popularly and Socially Considered," the author has attempted the difficult task of writing a popular work on a technical subject without omitting the details which are of most importance to the practical engineer. He has succeeded remarkably well on the whole, though something of systematic arrangement and conciseness had to be sacrificed in the attempt to make the book attractive to the general reader. The portion of the book describing the shops and machinery of the great English shipyards is of more technical value than the portion describing the ship itself, and more space is given to it. The author deserves much credit for the pains he has taken to describe the latest and most modern practice in every department; the common fault with technical books is that they are a year or more behind the times.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Sept. 20 a paper on "The Water-Works of Denver, Colo.," by Mr. Jas. D. Schuyler, M. Am. Soc. C. E., will be read and discussed.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF KANSAS CITY.
Sept. 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Sept. 11. Secy., M F. Schinke. City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Sept. 12. Secy., F. C. Osborn, Case Library Bldg.
ROAD MASTERS' ASSOCIATION OF AMERICA.
Sept. 12. 13 and 14. Annual Convention at Chicago, Ill. Secy., W. W. Sharpe, Waycross, Ga.
NORTHWEST RAILROAD CLUB.
Sept. 12. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Sept. 12. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 12. Secy., F. E. King, Jacobson Block.
MASTER CAR PAINTERS' ASSOCIATION.
Sept. 13, 14 and 15. Annual Convention at Milwaukee, Wis. Secy., Robert R. McKeon, Kent, O.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Sept. 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Sept. 13. Secy. F. M Curtis. O. C. R. R., Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Sept. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Sept. 14. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Sept. 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARHITECTS.
Sept. 15. 201 Washington Building.
SWEDISH ENGINEERS' CLUB.
Sept. 16. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Sept. 19. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 19. Secy., R. H. Clark, Pittsburg.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke, Va.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 20. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., F. Collingwood. 127 East 23d St., New York.
NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Sept. 21. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Sept. 21. Secy., C. F. Franson, Portland Block.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept. 21. Secy., S. A. Charpiot, Macon, Ga.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Sept. 22. Secy., C. H. McLeod, Montreal, P. Q.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Oct. 3. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Oct. 4. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 5. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Oct. 6. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 6. Secy., O. Von Geldern, 719 Market St., San Francisco
ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 7. Secy., L. F. Rondinella, 1122 Girard St.
INTERNATIONAL IRRIGATION CONGRESS.
Oct. 10-14. Los Angeles, Cal. Arthur L. Thomas, Sa Lake City, Utah, Chairman National Executive Committee.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 14. Secy., G. O. Foss, Helena.

ENGINEERING NEWS
AND
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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

◆

We reported last week the principal facts regarding the fatal rear collision on the Long Island R. R. on Aug. 26, but the coroner's investigation brings out further particulars of such great importance that they ought to be brought to the attention of every railway officer in he United States, especially those who have anything to do with block signaling. Briefly told, the circumstances of the accident were these: The Manhattan Beach train was stopped at Tower 5, a train being in the block ahead of it. The stop was not for more than a minute and the rear brakeman, who started back, had not time to go farther than 400 or 500 ft. when he was called in by the whistle and the train started. It had attained a speed of only five or six miles an hour when it was struck by the locomotive of the Rockaway Beach train. This train should have been stopped at Tower 6, in the rear, but Knott, the towerman at 5, signaled back to Tower 6 that the Block 5-6 was clear while the Manhattan Beach train was still standing in it. Just when he gave the clearance to Tower 6 is not certain, but apparently he gave it as soon as he had given the clear signal at his own tower to the Manhattan Beach train, thinking, as others have thought before him, that the train below would certainly get out of the way before any train in the rear would come up.

This was the first and fatal error. The blocks are short, only a mile long, and the Rockaway Beach train came ahead so fast from Tower 6 that it came in sight of Tower 5 while the white light was still displayed for the Manhattan Beach train to pull ahead. The signal at Tower 5 is so located that it can be seen only once from the fireman's side and through a break in the trees before the train is close on it. Towerman Knott displayed the red light when the second car of the Manhattan Beach train was opposite his tower, but the Rockaway Beach engineer had already seen the white light from that tower and was not warned of the danger until the tail lights of the Manhattan Beach train came into view.

◆

Of course, Towerman Knott was seriously at fault in giving the clearance signal to the tower in the rear while the block was still occupied; but he doubtless reasoned, as others have before him, that the train below would certainly pull ahead into the next block before any train in the rear could come up. How can men be taught the danger of such errors? Not by their own experience certainly; that is far too dear a teacher in this case. The only way, apparently, is by constant precept to teach them the danger that lies in every departure from the strict order of duty laid down in the rules. Such an object lesson as that on the Long Island road should be taken advantage of and brought to the attention of every towerman who is in a position where he might repeat Knott's fatal mistake.

English experience has shown that signalmen can be trained to wellnigh absolute obedience to rules; but the training must be thoroughly done and for the highest results we must wait until this implicit obedience has been so long practiced that it becomes second nature.

On the other hand, accidents like those on the Long Island road are powerful arguments for those who hold that automatic block signals are superior to the hand operated; and that no block system is as safe as it should be unless the traffic is protected against such mistakes as that of Signalman Knott by electric locks connected with track circuits, which prevent clear signals from being given until the train has actually passed out of the block.

◆

The Long Island road, however, may argue that it cannot afford a complete Sykes system, and that the appliances which it has in use are as good as its traffic will warrant and better than are in use on many other roads of heavier traffic. It is difficult to find an excuse, however, for the company's neglect to make use of distant signals. With the short blocks in use here the home signal at the entrance to one block should be the distant signal for the block beyond it. Reliance on the engineer distinguishing the signal when he is far enough away to stop before he reaches it is a very unsafe practice where fast trains are run. The evidence presented before the coroner's jury showed that the engineer could not stop his train after he had a fair view of the signal light without running into the next block. Had he been warned by a green light at Tower 6, however, that the signal at Tower 5 was standing at danger, he would have approached it with his train under control.

Another portion of the evidence which has thus far passed without comment is that in relation to the brake equipment. The Long Island road still uses the vacuum brake on some of its passenger trains, although it began equipping with the Westinghouse quick-action brake about two years ago; and, according to the testimony, the Rockaway Beach train was equipped with vacuum brakes. Moreover, while the locomotives of this train had driver brakes, they were not connected to operate with the train brakes, and the engineer testified that an order from the Superintendent of Motive Power was in force forbidding the use of the driver brake. The testimony showed that the train was running only 25 to 35 miles an hour and steam was shut off. With the quick-action brake applied to all the wheels of the train at the time when the engineer applied his vacuum brake, the force of the collision would have been greatly reduced and it might even have been so slight as to have caused neither deaths nor injuries. We trust this object lesson in the results of bad brake practice may not be lost, especially on those officials who still cling to the theory that the driver brake is an appliance which should be reserved for emergencies, the result being that in an emergency the engineer never thinks of the driver brake.

THE NEW WORK OF THE RAPID TRANSIT COMMISSION.

The New York Rapid Transit Commission is again commencing its weary round in search of relief for the citizens of this city, and every one fervently hopes that its present efforts may yield more satisfactory results than those that followed the last paroxysm of activity. As we view it, the Commission has wisely dropped all consideration of dealing with extensions of the existing elevated systems; wisely, we say, for any arrangement in that direction would, or should, have compelled the entire rebuilding of the structures now standing, which were never designed for the loads or speed of trains which the specifications of the present Commission and the needs of traffic demand. The Commission now goes back to where it was months ago and stands ready, we trust, to invite the attention of engineers and builders to the design and construction of an underground system on more clearly defined and better digested terms. In our issue of Nov. 24, 1892, the terms of the sale of the franchise, as then laid down by the Commission, were fully commented upon and its many weak features were pointed out. It was then foretold that capital would not seriously consider the project at all under the conditions imposed, and the public need not be told that that prediction came true.

There was a saving clause in the franchise sale, however, and that was that the Commission might reject all bids and re-advertise the franchise "under the same or different terms of sale as often as it may deem it necessary in the interest of the city of New York," and to accept only "that bid which under all the circumstances is in its opinion most advantageous to the public and the city." No bids worth considering were received at all, but instead of modifying the terms of sale and attempting to invite bids upon a fairer basis, both to the city and to the owners of capital, the Commission seemed to assume that its whole duty was fulfilled in that direction and that any other conditions were impossible, and at once began negotiations with the owners of the Manhattan elevated system. The only result of this policy has been a waste of valuable time, an overstrain of public patience and a return to the original situation of several years ago.

Assuming that all parties concerned have gained some wisdom by their experience—and this is the only gain that we can assume—it remains now for the Commission to outline an entirely new scheme of construction and control. If we may be allowed to advise, future negotiations should be conducted somewhat on the following lines: First, select a complete route, the best that natural conditions combined with the needs of traffic can suggest; then divide this completed system into sections according to urgency of traffic demands and priority of construction. It is not necessary to assume that the whole route must be contracted for and built at once; any relief to present congestion of travel is material relief and the impetus given to traffic and the experience gained in opening up one line will greatly assist in determining the methods which should control the building of other links in the completed chain. As to construction, there are two ways open to the Commission. Either let the city build and own the route and then lease it under just and clearly defined terms to the best bidder; or let the construction by contract under conditions which will firmly bind the builder and hold him responsible for general results, and will yet not hamper him in the petty details of construction and leave him wholly at the mercy of future commissioners who may or may not be uninfluenced politically for or against the builders. All the interests of the builder can be so centered that only sound and permanent work will relieve him from his responsibility, and under such conditions the details can be safely left to his own discretion without petty and annoying supervision, which often fails to supervise as was the case on the New Croton Aqueduct. And finally, however the rapid transit road may be built, by the city or for the city, let it distinctly be understood that the city of New York is to own the road and operate it in the near future. The law provides for this end after "a definite term of years," and the proposed sale for 999 years was an evasion of this law, for it was practically a perpetual lease, and, under the original terms of sale, a lease with absurdly loose provisions for control of equipment or operation.

Under properly intelligent engineering control and perfected plans an underground railway is perfectly practicable, as much so as an elevated structure, and it is for the Commission to seek for itself, or obtain from others, the data which will enable it to select the most economical plans and those best adapted to meet the demands of true rapid transit. While all negotiations are nominally open to the public, there has been as yet no properly formulated invitation to the engineers of all nations to present such plans as they may have for solving what is in truth a complicated problem. The old saying that "in a multitude of counsellors there is safety" applies practically to this case, for the Commission cannot assume to itself all the engineering wisdom and experience of the world. The law controlling the Commission imposes upon it a task that, with all due respect, it is not competent to carry out alone. It is "to prepare detailed plans and specifications for construction, including all devices and appurtenances" necessary to secure "the greatest efficiency, public convenience and safety" of a rapid transit road or roads, and the law goes on to specify that this includes suitable plans and specifications for "supports, turnouts, sidings, connections, landing places, buildings, platforms, stairways, elevators, telegraph and signal devices, etc." All this the law says shall be done before a sale of the franchise is attempted. It is here we say that not one engineer, but many engineers, should be consulted, and these engineers should be the most experienced in their special lines that this country or any other can afford. Until the present Commission fully realizes the real dimensions of the task set before it and shows the public that it is capable of work on broader lines than have been heretofore followed, the citizens of New York may be excused for having little more faith in future deliberations than they have in the wasted efforts of the past two years.

THE LAST GREAT BRIDGE DISASTER.

Coincidences are often deceptive, and it is not fair that too much should be made of them, yet surely it is a notable coincidence at least that the last great truss bridge disaster preceding that on the Boston & Albany R. R. on Aug. 31 should also have been in Massachusetts, should also have occurred to an aged, re-tinkered structure, should also have resulted solely from neglect of universally understood elementary requirements, should also have been made possible only by errors of method extending through quite a chain of officials from the president down, and should also have been accompanied by an entire lack of engineering superintendence on behalf of the companies.

These facts are surely more than mere coincidences. They indicate rather some undue defects of administration. It is a fact which we have often had occasion to point out, that railway accidents due to defects of way and works are much more common proportionately in New England than in other parts of this country or of foreign countries under at all analogous conditions. They are the least excusable class of accidents. No class of accidents can ever be wholly eliminated, but the easiest of all to avoid are those due to inherent statical weaknesses, and the hardest, those due to the process of moving trains, like collisions and switch derailments. Accordingly, we find a steady tendency in all civilized countries to eliminate all but train-movement accidents, so that failures of structure under a train are getting to be extremely rare, and when they do occur, as in the Tay Bridge disaster of Dec. 28, 1879, they can generally be traced to some distinct cause, which in that case was a defective state of the art of bridge building in England, which extended so far that one of the most prominent practitioners in England, an engineer of large practice and experience, was not informed as to certain elementary necessities for stability. That was mortifying and bad enough; but after all, ignorance is not a crime, and in insuring that the great bridge was built under an engineer of high rank and supposed competency all was done that could be done, or reasonably expected at least, to insure safety.

But the peculiarity of this last disaster, which was also a peculiarity of the Bussey Bridge disaster, is that it is directly chargeable to a most astounding and most culpable carelessness combined with ignorance among those in immediate charge of the work, if not among the company's officers generally. In reviewing the whole record of great bridge disasters at the time of the Bussey Bridge disaster (March 19, 1887) we said as to the latter:

> The entire sequence of events in this disaster is now entirely clear, and, taking all the circumstances together, it shows it to be the least excusable bridge disaster of magnitude which has ever occurred.

Nothing has occurred in the 6½ years which have elapsed since this was written to lead us to modify this conclusion, nor has any bridge accident occurred in the interval to make the statement less true to-day than it was when written until this last disaster at Chester, which, by an unforunate coincidence, is also in Massachusetts. But of this last disaster, unless mitigating circumstances are brought to light which have not yet appeared, it is certainly still more true to say that it is the least excusable bridge disaster of magnitude which has ever occurred, as indicating not only merely gross individual carelessness, but certain radical underlying errors of practice and method.

This would still remain true, even if the case should assume a considerably better aspect under the official investigation which is to occur this week than there now appears any reason to expect. Until all this evidence has been taken, we do not care to express any opinion upon the responsibility of individuals nor upon the facts in detail; but the main facts of the occurrence, so far as they have been made public, are these:

The company has a regular staff of engineers in its service, including a chief engineer, assistant engineer and bridge engineer, whose positions are regarded as of such importance that their names are included in the usual published lists of the higher officials. We hesitate to believe that no one of these engineers was maintaining at least a nominal continuous supervision over work that was in process of execution under a contractor, but if there was such supervision the fact has not yet been so publicly announced that it has come to our knowledge. The work in progress was of the most delicate character, consisting in strengthening a number of old and infirm iron bridges while still in service and without support by falseworks. So far as yet appears it was turned over en bloc to a local and far from conspicuous bridge-building firm, by whom it was turned over to a foreman, by whom it was turned over to a gang of four or five workmen. They had removed part of the rivets from the top chord preparatory to adding strengthening plates, thus materially weakening the already weak structure. Quitting time came and they went off to dinner, leaving the bridge in this condition. The fated train came shortly after and the bridge collapsed. Their foreman had left them half an hour before.

In this sequence of events there was far more than that individual carelessness which can never be wholly eliminated or guarded against, and against which, consequently, no care can be a perfect check. The least blameworthy of all concerned were the four common workmen who were the immediate cause of the catastrophe. They are not paid nor expected to understand the relation of strains to strength, but only to do what they are told. Their foreman must necessarily have been an utterly unfit man, and not simply careless, or he could not have gone off half an hour before dinner leaving his men in the act of materially weakening a bridge over which trains were passing hourly without cautioning them that they must complete their work before they left it. Unless he had express authority also he could not, if a competent man, have left a bridge in this weakened condition open for a minute for the passage of trains unless it was fit to leave in the same condition for a week, for it is evident that the greatest risk from a weakened bridge is to the first train which passes over it, and this risk is as great in a five-minute interval in a strengthening process as if the bridge were to stand in the same condition for years.

Yet if there was any rule established or enforced at any time to require flagging of trains in such intervals of weakness, the fact has not become known, and all the circumstances indicate that there was no such rule, as certainly there was no such rule enforced. If so, the responsibility for the lack of such an evidently necessary rule comes directly home to the contractors, as does the responsibility for having such a conspicuously ignorant foreman in charge of such important work in any case.

Had the contractors had an adequate appreciation of the risks involved in tampering with bridge members under service, they could not possibly have had any work for which they were responsible going on under the conditions which actually existed; but if the contractors could not, how about the company's engineers? Without desiring to add in any way to the burden which this company is now carrying, it must be said that the bridge company making the repairs was not a company of the first rank, of national reputation. To such a company it might, perhaps, be pardonable, though it would be unusual, to turn over certain repairs of structures with carte blanche as to the precautions to be adopted. Their reputation, experience and financial risk might conceivably be regarded as the best possible precaution; but what is to be said in excuse of engineering officers of the company for turning over such critical work to a firm of merely local prominence without insisting on such rules and maintaining such continuing supervision that it would be impossible for the contractors to leave the most critical work in the hands of common workmen, or to run a single train across a bridge in a weakened condition unless it was run over against danger signals? Such oversights as this cannot by any stretch of charity be brought under those breaches of trust by subordinates for which no superior can be held morally responsible, though he may be responsible in law. Both morally and legally the responsibility for this disaster goes right home to the engineering officers of the company, past the workmen and the foreman and the contractors' engineer and the contractors. Not they, but the officers of the company had the primary responsibility of insuring a reasonable degree of care for human life, and such reasonable degree of care was wholly lacking throughout the chain of responsibility which we have so far reviewed.

Does the chain extend any further? The present writer does not chance to know, and has taken no pains to find out. He knows, indeed, that no one of the three engineering officers who have been referred to, were members of the American Society of Civil Engineers. Had they been so, even as things now are, that would have been a positive evidence that they had attained a standing in their profession warranting their being intrusted with grave responsibilities; but that society has not yet reached the position to which it aspires and which it is greatly to be desired that it should reach, when it follows as a matter of course that every engineer is a member of the society who has the requisite standing to join it. Therefore, this fact is of only negative importance at most; but we should be recreant to our convictions of duty if we did not call every engineer's attention to the fact that when unpleasant accidents occur to works for which he is responsible, he stands in a far less pleasant light before the public than if he had secured beforehand from his professional peers that admission of a certain minimum of competency for charge of responsible work which is involved in admission to that society as a member. For it is certain that public and private corporations are too often both ignorant and careless as to the true qualifications of engineers whom they intrust with important duties; but a society of engineers which exists largely for the very purpose of separating the sheep from the goats is not so careless and not so ignorant. We are tempted to enlarge upon this subject, but we forbear lest it may seem to have a personal bearing which we disclaim, except to this extent: Whenever we find bad accidents happening to works in charge of engineers unknown to use and not members of that society, it creates in our mind doubts which would not otherwise exist as to whether his professional record is such as would have warranted a careful company in placing such works in his charge; and we freely and frankly state as much; not forgetting, however, that these doubts may in some cases prove to be wholly unnecessary. In most cases, even as things now are, they will prove to be justified.

We earnestly hope that all the facts of this disaster will be probed to the bottom in the coming investigation, which cannot be done unless the investigation extends considerably beyond the immediate chain of events in this particular disaster. How many other bridges on the same roads or on other roads in the state, under the same or other engineers and contractors and foremen and workmen, have been handled as this one was? Have any of those concerned been in the regular habit of weakening bridges in any way for however short a time without stopping travel over them during the period of weakness? Is it a "regular thing" among any of those concerned to leave bridges in weakened condition while men are eating dinner? These and other questions of the kind open a wide field of investigation which should not be overlooked.

LETTERS TO THE EDITOR.

TESTING MACHINES AND THE NIAGARA SUSPENSION BRIDGE.

Sir: The Riehle Bros. Testing Machine Co. has an exhibit in the Machinery Building, World's Columbian Exposition, Column O 25, of various testing machines.

In connection therewith, cards are distributed by this firm, one of which I inclose, and in which occurs the following statement:

> One of these instruments is that used by Col. W. H. Paine in building the famous Brooklyn Bridge, and was the means of saving the Niagara Suspension Bridge after it had been condemned by two eminent engineers.

From the context it appears that this instrument was simply used to ascertain the stretch of the cables when loading the bridge with cars and locomotives.

Now, while the late Colonel Paine may have used this machine at the Niagara Suspension Bridge for such purposes as it is good for, it is not correct to say that it saved the bridge after it had been condemned by two eminent engineers. Colonel Paine is not known to have made any such claim himself. It is well known to most bridge engineers that the repairs found necessary in that structure, and particularly to the cables, were not determined by that instrument, but by means entirely unconnected with it. It is regrettable that romancing of this kind should be resorted to for advertising purposes, and it appears but proper to correct the false impression it conveys.

Bridge Engineer.

New York, Aug. 19, 1893.

(The reverse side of the card referred to in the above letter gives the following more detailed statement:

> In Our Showcase May Be Seen the Instrument which Saved the Niagara Suspension Bridge.
>
> This instrument was made by Col. W. H. Paine, and used by him during the construction of the Brooklyn Bridge. During that time the Niagara Bridge was condemned as unsafe, by two eminent engineers, but before giving it up they sent for Colonel Paine, who came and had the bridge first loaded from end to end with cars, and measured the stretch of the cables with this instrument. Afterward locomotives were run on and the track filled with them, they being the heaviest loads possible to put on the bridge. Colonel Paine found that he could give the weight of each locomotive or car by reading the stretch of the cables, and as this stretch was uniform, it showed that the elastic limit had not been reached and that the cables were entirely safe. The bridge is still in use.

We must confess that we do not quite see that the advertiser has committed any sin above that which is common among men, according to the above account. It would have been more accurate doubtless, to have given somewhat less credit to the instrument and more to the man, but one does not look for precise definitions or statements on the placards in an Exposition, which appeal to the general public. The chief point which seems open to criticism is the question of fact whether the bridge was actually "condemned as unsafe by two eminent engineers." It is certainly a reflection on the engineering profession if two eminent members thereof condemned a structure which a third afterward tested and found safe. The only information which we find on this point is the following, from Mr. L. L. Buck's paper (Trans. Am. Soc. C. E., vol. X, p. 199):

> In February, 1877, Mr. Thos. C. Clarke, M. Am. Soc. C. E., visited the bridge and caused an examination to be made in the masonry covering the strands of the Canadian end of the lower north cable. On reaching the strands near the shoes, two or three of the outside wires were found to be corroded quite through, and a number of others were more or less corroded, and presented an appearance that was not very encouraging. In view of the possible extent that the deterioration might have reached, it was deemed best to reduce the weight of the trains crossing the bridge until a more thorough examination could be made.
>
> Shortly afterward Col. W. H. Paine, M. Am. Soc. C. E., of the East River Bridge, went to Niagara and proceeded to make a thorough examination. Men were set to work removing all the masonry from the strands and the first lengths of the chains. With a vernier scale he measured the elongation of the strands produced by a load on the bridge. * * * * The elongation of the strands under a given load was found to be what the modulus of the wires would give if the section was full, showing that the corrosion had not reduced the section of the strands so much as would be allowable without weakening the cable as a whole, for the reason that the stress at the top of the tower exceeded that at the strands by about the strength of 40 wires.

We have submitted a proof of "Bridge Engineer's" letter to the Riehle Testing Machine Co. and append the reply of their representative at the Exposition.—Ed.)

In reply to your favor of the 28th inst. to the Riehle Bros. Testing Machine Company in reference to a letter received from "Bridge Engineer," objecting to the card on the original extensometer used by Colonel Paine in examining the Niagara Suspension Bridge, allow me to say that the card in question was printed at my suggestion because I found that it was a lively source of satisfaction to engineers to see the instrument, and not for purposes of advertisement.

The statement made on the card is as it was made to me by Colonel Paine, and because it did save the bridge. The bridge might, and probably would, have been saved by the Colonel by the use of some other instrument had not this one happened to be the one used. The other engineers who were first called might not have condemned the bridge had they thought of some way to test it. Columbus stood the egg on end, and the wise men who did not think of his way belittled him. But to return to the card in question, in writing it I repeated Colonel Paine's words, viz., "it saved Niagara Suspension Bridge." That is the way he stated it to me a short time before his death.

Very truly yours,

Jno. R. Matlack, Jr., M. Am. Soc., M. E., Machinery Building, W. C. E., Chicago, Aug. 31, 1893.

EQUIVALENT UNIFORMLY DISTRIBUTED LOADS.

Sir: In 1883 I had occasion to get out quite a number of diagrams of equivalent uniformly distributed loads corresponding in their static effect on bridges to certain systems of concentrated axle loads of railroad trains.

The diagrams for the equivalent uniformly distributed load per lineal foot, causing the same vertical shearing force as the concentrated axle loads, were based on the following law originated by me in 1881:

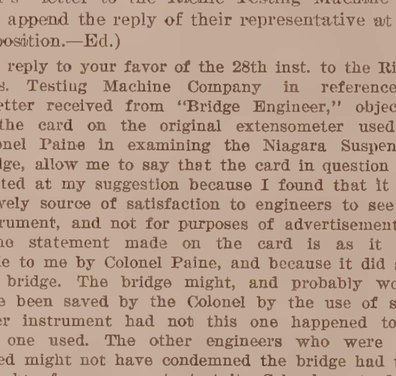


Diagram Showing Equivalent Uniform Load for Shear.

The equivalent uniformly distributed load per lineal unit causing the same vertical shearing force as a system of concentrated axle loads is a function of the character of the system of concentrated loads and its position on the span, but is independent of the total length of the span.

In other words: If a train has advanced on the span up to 100 ft. from the end of the span the corresponding equivalent uniform load per lineal foot causing the same shear in front of the train is the same for a 200 ft., 500 ft. or any span.

It is, therefore, possible to show the equivalent uniform load per lineal foot for a shear in a diagram as follows:

To obtain the vertical shear S substitute in the formula:

$$S = \frac{l^2}{2\,L} \times g,$$

for "g" the amount corresponding in the diagram to l.

I should be pleased to ascertain through your kindness and the assistance of the readers of the Engineering News when and where the above law has been published first. To my knowledge it has not been published so far.

Wm. F. Waag, C. E.

St. Louis, Mo., Aug. 24, 1893.

BORED GUIDES OR BUILT GUIDES IN STEAM ENGINE CONSTRUCTION.

Sir: In your issue of Aug. 24, p. 148, you state that builders of high-speed steam engines have made many improvements, substituting built-up guides for bored guides, etc. It would be interesting to have the points of superiority of the former style detailed, or rather a comparison of the good and bad features of each.

Very respectfully, W. H. Warrington,
President Vulcan Iron Works.

Chicago, Aug. 26, 1893.

(The main reason why built-up guides seem to us to be superior to the bored guides is that a much lighter cross-head can be conveniently used, with larger bearing surface; for high-speed engines at least most engineers now concede that lessening the weight of reciprocating parts and increasing the cross-head rubbing surface are important advantages. It may be said that guides cast in one piece with the cylinder cannot lose their alinement; but, on the other hand, they cannot be adjusted to take up wear as can the built-up guides, but the cross-head must be made of more or less complicated construction so that wear may be taken up there. Again if the guides are bored from a center in line with the axis of the cylinder, the only thing to prevent a twisting motion of the piston and crosshead around their central axis is their connection to the crank. Many engine builders who cast the guides in one piece with the cylinder make V-shaped guides instead of boring them, although the bored guide can, we believe, be more cheaply made. The subject might be discussed pro and con at much greater length, but we leave it for any of our readers who may have experience or arguments to present.—Ed.)

NOTES AND QUERIES.

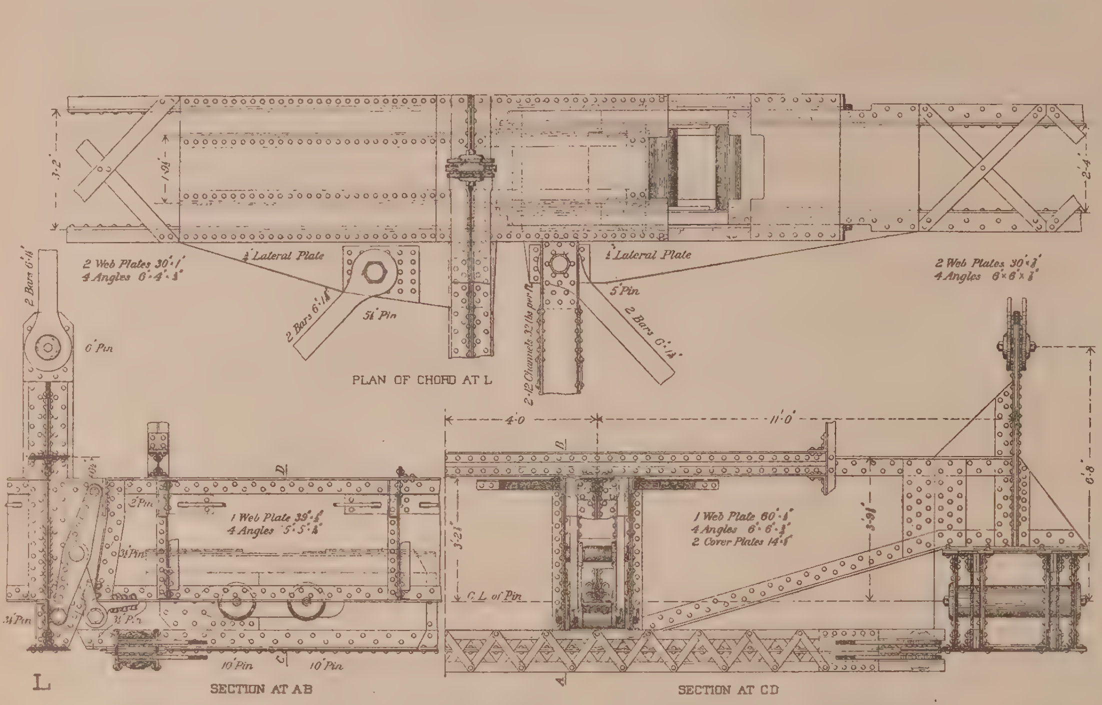
A correspondent inquires if within the last four years any roof arches have been built with the feet rigidly fixed and a flexible joint at the crown; the foundations taking both the horizontal thrust and the vertical load, and the flexible joint allowing for the expansion. Do any of our readers know of such a construction?

R. H. L., of Ensenada, L. Cal., asks information as to the best preservative for iron and steel submerged in sea water. Common Swedish tar is recommended by Trautwine, but we fail to find at hand detailed accounts of other preservatives. In this connection it may be said that Mr. Thomas Andrews has published a valuable paper, in Minutes of Proceedings of the Institution of Civil Engineers, vol. LXXXII., p. 281, on the Corrosion of Metals During Long Exposure in Sea Water; but while he enters fully into the effect and rate of corrosion he does not refer to means of preservation. Perhaps some of our readers will kindly advise our correspondent from their own experience.

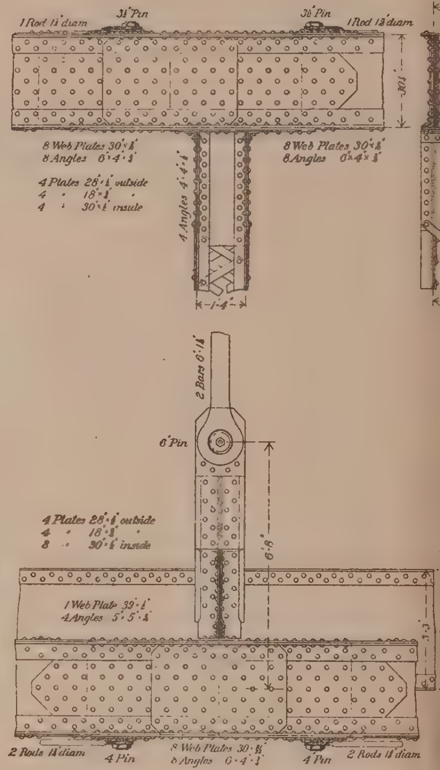
SPECIAL STRUCTURAL DETAILS FOR THE MEMPHIS BRIDGE.

(With inset.)

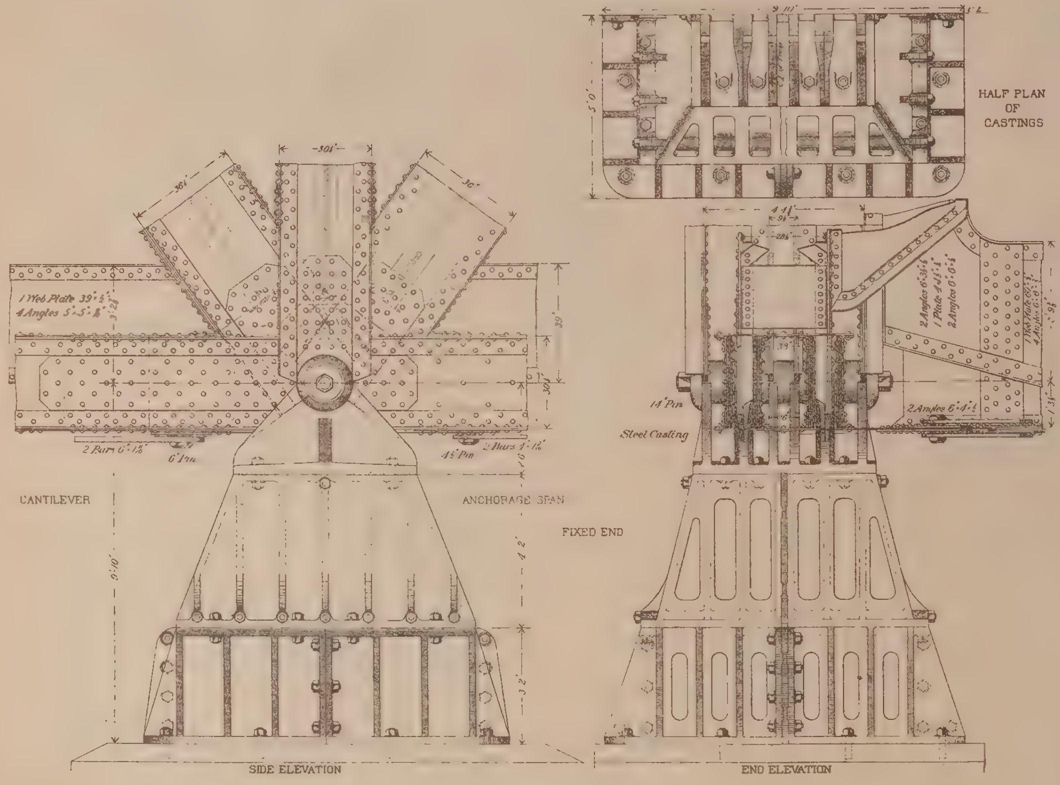
In our issue of May 12, 1892, we described the principal features of the large cantilever bridge across the Mississippi River at Memphis, Tenn., and in succeeding issues, June 16 and Sept. 15, 1892, illustrated the general design and construction of the large steel trusses. The design of the structural details for a bridge of the size and importance of this, however, calls for hardly less engineering ability than is required in the design of the general plans. We show the structural details of most interest on our inset sheet this week. For these drawings and the information from which the following description has been prepared, we are indebted to a paper presented at the International Engineering Congress, by Mr. Geo. S.



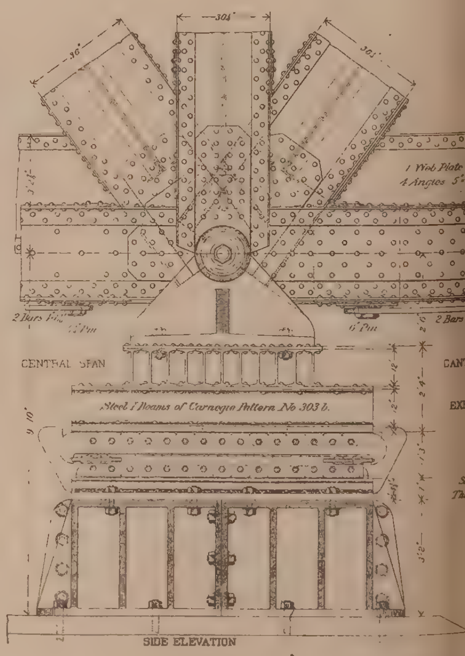
EXPANSION JOINT, LOWER CHORD AND STRINGERS, INTERMEDIATE SPAN.



RIVETED JOINT



FIXED BEARINGS, PIERS 1 AND 3.



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SPECIAL STRUCTURAL D

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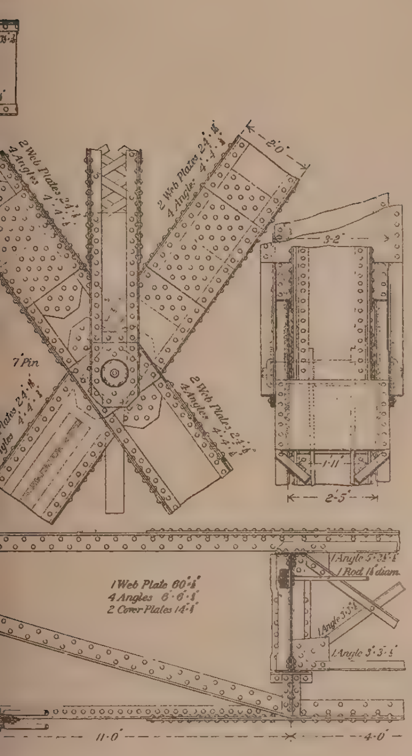
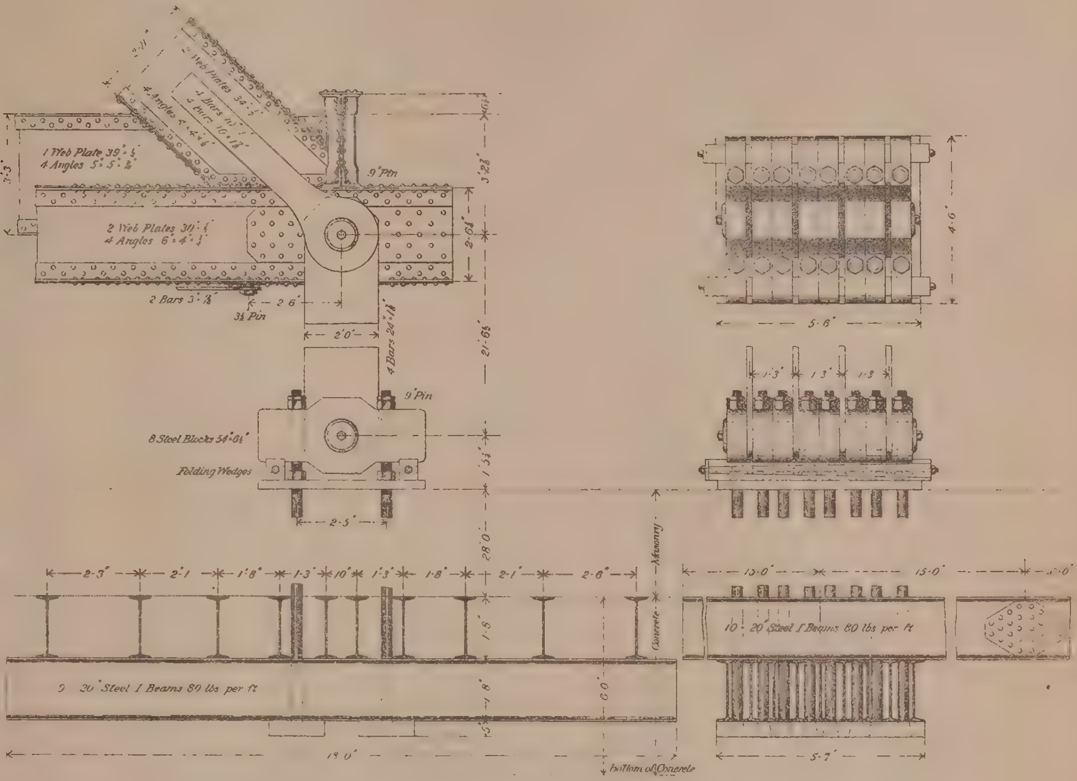
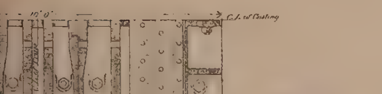
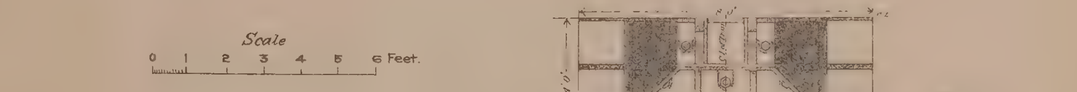


EDIATE SPAN.



ANCHORAGE CONNECTIONS.





BEARING, PIER 4.

HE MEMPHIS BRIDGE.

gineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

Morison, M. Am. Soc. C. E., who designed the bridge and superintended its construction:

In order to fully understand these details it is necessary to review some of the conditions influencing the general design of the bridge. The act of Congress authorizing the bridge required the channel span to be not less than 700 ft. in length and the other spans not less than 600 ft. Moreover, the channel span must be next to the east shore. The length fixed for the channel span was therefore 790 ft:, or 170 ft. more than either of the other spans. By projecting a cantilever 170 ft. long from Pier 1 (on the Tennessee shore), the distance between the end of this cantilever and Pier 4 (on the Arkansas shore) was divided by the two other piers into three equal spaces of 620 ft. each. By making the central span a fixed span with continuous chords and projecting a cantilever 170 ft. long from each end of this fixed span, there remained two spaces each 450 ft. long to complete the bridge, one of these being between two cantilevers, and the other between a cantilever and Pier 4. With this arrangement the bridge would consist of a central span 620 ft. long, of three 170-ft. cantilevers precisely alike, and of two 450-ft. spans also alike, besides the anchorage span east of Pier 1.

In order to simplify construction it was desirable to make the panels of uniform length throughout, and this required that the panel lengths should be common divisors of the lengths of the cantilevers, of the suspended spans and of the central span. No such common divisors existed for 170 ft. and 450 ft., but by shortening the length of the cantilevers to 169 ft. 4½ ins. and increasing the length of the suspended span to 451 ft. 8 ins., 56 ft. 5½ ins. became a common divisor. The lengths were, therefore, slightly changed, and a panel 56 ft. 5½ ins. long was made the unit for the entire bridge, this panel being divided into two panels in the floor system. Each cantilever arm was divided into three panels, each suspended span into eight panels, and the central span into 11 panels.

The next thing to determine was the width, and the principal limit in determining this was the length of the central span. This being 620 ft., it did not seem wise to make the width of the trusses less than 30 ft. In determining the depth of the trusses other considerations than economy of metal work governed. The difficulties of erection made it important to keep the dimensions within limits to which ordinary falsework could be adapted. The magnitude of the structure and its cantilever design made it important to use such proportions that vibrations would be reduced to a minimum. It was not thought best to make the depth at any part of the superstructure much more than 2½ times the breadth of base. The breadth of base could not be increased without increasing the length of the piers, which would have added to the already excessive cost of the foundations. By fixing the depth of both the central and the suspended spans at ⅛ of the span and making all three of the cantilevers alike, the depth of the structure over each of the piers and for the whole length of the central span became 77 ft. 7 13-16 ins., and the depth of the suspended spans, 56 ft. 5¼ ins. These dimensions were adopted.

The form of trusses adopted was the double triangular or double Warren girder. It was intended to erect the channel span without falsework, building out from either end, and this form of truss was thought to have advantages in the manner in which it sustained the upper chord from which the work would be done.

The general dimensions and form of truss having been adopted, it next became necessary to fix the character of the principal details. The American form of construction with pin connections was adopted from the first. The chords of the central span, being subject to reversals of strains from the action of the cantilevers, were necessarily both made stiff, and the same stiff bottom chords were necessarily extended out as the bottom chords of the cantilevers. The top chords of the cantilevers, being always in tension, were made of eyebars. As the east suspended span (in the channel span) was to be erected without falsework, the two halves being built out as continuations of the cantilevers, it was necessary that the bottom chord of this truss should also be made stiff for the greater part of its length, while the top chord, being in compression in the finished structure, was of course stiff. It was determined to sacrifice some material and to make the bottom chord of the suspended span stiff throughout, and to make both suspended spans (or intermediate spans, as they were called on the drawings) with stiff chords throughout. The chords of the anchorage arm correspond to those of the cantilevers. The bottom chord is therefore stiff throughout the entire length of the superstructure, and the only portions of the top chord which are made of eyebars are in the anchorage and cantilever arms and in the end half panels of the central span, this special arrangement being adopted from the difficulties of packing a stiff chord into an eyebar chord at the extreme ends of the span.

The stiff chord provision undoubtedly adds to the lateral stiffness of the bridge, and, to a certain extent, to its vertical stiffness. The sliding joints at the ends of the cantilevers are carefully fitted, and in spite of its cantilever construction the bridge is very free from vibration. The lateral bracing is formed of diagonal rods attached to pin plates riveted to the chords, and so placed that the axial lines intersect at the center of each chord. The lateral bracing is adjustable and is the only adjustable portion of the bridge.

The transverse bracing is rigid throughout and is made in the form of lattice frames so as to stiffen not merely the center of each post but intermediate points above.

The floor system consists of two stringers placed 8 ft. between centers, these stringers being riveted to the webs of the floor beams at each panel and half-panel point. At the full panel points the floor beams are supported on short posts to which they are riveted, which posts rest directly on the pins. At the half-panel points the floor beams are suspended from the web intersections above.

Although the width between trusses is sufficient for a double-track bridge, the bridge, being designed for but a single track, has but two lines of stringers. It should, however, be mentioned that, though designed for a single track only, the bridge is at least 2½ times as strong as some important single track bridges built less than 15 years ago.

The stiff chords of the central span, including one full panel of the bottom chords of each adjoining cantilever, were made with four webs. This form of construction was adopted for two reasons: First, to reduce the thickness of the metal, and so to reduce the lengths of the rivets in the splices; the second object was to reduce the bending strains on the pins. The connections with the web members are all made in the narrow spaces between the outside and the interior webs, so that the pins, by which the whole horizontal strains are transferred to the chords, are supported at four points, and the unsupported length is reduced to a minimum. The objection to high theoretical bending strains in pins is not so much the danger to the structure from the failure of the pins as the fact that by the distortion of the pins the strains may be distributed unequally among the several pieces attaching to them. With the arrangement adopted here, this danger is reduced to a minimum.

The four-web chords are confined to 10 full (20 half) panels of the top chord of the central span, to 11 full panels of the bottom chord of the same span, two full panels of each cantilever arm and two full panels of the anchorage arm. Two-web chords were used in the remaining bottom panels of the cantilever and anchorage arms and throughout the whole length of the suspended spans. In the bottom chords of the suspended spans the rivets became objectionably long.

The sections of the stiff chords were generally made in full-panel lengths, 56 ft. 5½ ins. long, the riveted joints being placed midway between the panel points and over the intermediate points; the only exceptions to this rule were in the upper chords of the intermediate spans and the lower chords of the cantilever arms and anchorage span. The details of the riveted joints are given in the drawings.

The shortness of the anchorage arm insures the connection being always in tension and never in compression. The masonry of the anchorage pier is built on a platform of I-beams, as shown on the inset sheet. Under this platform are placed steel washer-plates with conical sockets through which the anchor rods pass, the weight being transferred to the anchor rods on conical counter-sunk heads. The anchor rods are built solid into the masonry, and run through steel plates on top. The top of the rod is turned down, and screws of two different diameters are cut on it. The nuts on the lower screw, 3½ ins. in diameter, screw up against the plates on top of the masonry, thus taking up any possible slack in advance of strain. The upper smaller screws, 3⅛ ins. in diameter, carry two nuts, besides a check nut on top, and these two nuts hold between them the cross-blocks which carry the pin on which the outside anchor rods attach. Under each truss there are 16 rods in the masonry, these rods connecting with eight blocks which carry the single pin on which four anchor bars connect. These anchor bars are simply flat bars of steel with pin holes at top and bottom. After the adjustment of the structure, folding wedges were placed between the steel plate and the blocks and tightened up so as to prevent any possible horizontal bending strain on the anchor rods. On the center of the pier was placed a tetrapod of steel, the four corners of which were anchored to the masonry, and the apex of which fits into a guide at the center of the end floor beam, the connection being such that no weight can be thrown upon it, but a full horizontal stiffening is obtained.

The general arrangement of the anchorage is such as to place all adjustable or movable parts in the open air above the masonry in plain sight, there being no unexposed portions and no iron work buried in chambers, the only iron out of sight being the long rods and the I-beam platforms, which being buried solid in Portland cement are protected from oxidation, while there is a large excess of material in the rods.

The superstructure and moving load throw on each of the two points of support on piers 1, 2 and 3, a weight of about 2,000 tons, this weight, however, being thrown directly over the axis of the pier. To distribute this weight properly on the masonry requires an area of about 100 sq. ft., and a sufficient height between the masonry and the chords of the superstructure to distribute it with some degree of uniformity. On piers 1 and 2 the bearings are fixed, as shown. In each instance the weight is transferred first to a 14-in. pin passing through the center of the chord. The three posts, one vertical and two inclined, rest on this pin, being made with semi-circular pin bearings at the ends, no pin plates passing around the pins, this arrangement being adopted partly for convenience in erection and partly because the weight always carried here is so great that nothing approaching to tension can ever exist. This 14-in. pin rests on a steel casting, cast with ribs placed directly under the bearings of the posts on the pin. The inclined posts are two-web posts, and the vertical posts four-web posts, but they are so packed that the whole weight is transferred to six ribs in the castings. The steel casting rests on two iron castings which are packed with long bolts and locked together with a grooved steel plate between them. These two castings rest again on four castings, which are locked together in the same manner at the center. The whole was fastened together by turned bolts passing through drilled holes. The actual weight of each pedestal casting between the pin and the masonry is about 45 tons. The center of the 14-in. pin is 9 ft. 10 ins. above the masonry, which brings the top of the stringer of the bridge 13 ft. above the masonry.

On pier 2, the bearing, which carries the same weight as those on piers 1 and 3, had to be made an expansion bearing to allow for the expansion of the central span, temperature alone here representing an expansion of about 8 ins. The piers are slender and the expansion great; it was therefore deemed necessary to provide a joint which would move with the least possible friction and which should not be liable ever to become clogged or stopped by the collection of dirt. The joint must also be so arranged that the structure would be held laterally and the motion limited longitudinally. It was therefore determined to use rollers 15 ins. in diameter and to make these segmental rollers of a pattern resembling the European practice, the rollers being placed 6 ins. between centers.

Each expansion bearing as constructed consists, first, of a steel casting, precisely similar to those used at the fixed end. This steel casting rests on a bolster composed of a horizontal top plate, then of eleven 12-in I-beams running transversely, of a second horizontal plate, of sixteen 12-in. I-beams running longitudinally, and of a third and thicker horizontal plate, the lower surface of which is polished smooth. It had originally been intended to make this bolster of two steel castings with a planed steel plate between them, and this arrangement would have been preferred; but the delays in getting the castings, and the uncertainty of securing the finished product in time, made it necessary (after three castings had been made and rejected) to change the plan.

Under the bolsters came the rollers. The rollers are in two lengths and are separated by two steel guide-plates, one of which is built in between the polished bottom plates of the bolster, and the other between the iron castings below. These serve as the transverse guides. There are 30 rollers in each joint, 15 on each side of the central guides. The rolling surfaces of these rollers are polished, and each roller has two holes drilled completely through it, through which pass turned rods, so that the rollers on one side of the center must always work with those on the other, while the distances between the rollers are kept constant by two side-plates drilled to fit the rods, the rods being held in place by nuts outside the side-plates. The upper side-plates are made with hooked ends, which, striking against the ends of the lower side-plates, limit the possible motion of the rollers and prevent any possible overturning.

Under the rollers is the bearing plate (commonly called the rail plate). It is formed of T-rails riveted on a plate below, the tops of the rails being about ¼-in. apart, and the top surfaces planed and polished. This arrangement makes a stiff surface for the rollers to roll upon, and provides adequate means for cleaning. The rail plates are in two parts, divided by the center plate which guides the rollers.

The motion of the top bearing is further limited by a lock plate which is fitted over the lower guide plate, the upper jaws of which would strike the edges of the top bearing plate before a motion could occur which might cause the top plate to slide on the rollers. Under the rail plates are the castings, which bear directly on the masonry and are like the lower sections of the fixed end castings. The result of this arrangement is a very sensitive and very powerful expansion bearing. For convenience of observation it was fitted with vernier scales, and the record which has been kept of the motion so far, indicates that this bearing works practically without friction.

A somewhat different form of support was used at the end of the intermediate span over Pier 4. Here, also, the weight is distributed on the masonry by iron castings, and the weight is transferred to the iron castings through a pin on a steel casting; but the pin is placed below the level of the chord, the whole weight being transferred by a small upright support, which also holds the floor beam. While this works fairly well, it is not as satisfactory a detail as the other bearings. It was adopted with a view to keeping the construction of this particular panel point as nearly uniform as possible in the four places where it occurs, this supported upright taking the place of the suspended uprights at the other three points.

The expansion between the cantilevers and the suspended spans is taken up by sliding joints in the top and bottom chords, the long suspender swinging. No special addition was made to this suspender in consequence of this swinging motion, the extra strain which can possibly be produced in this way being less than that which is usually produced in horizontal eye-bars by their own weight. The sliding joint in the bottom chord is placed in the last panel of the cantilever. The sliding joint in the top chord is placed in the first panel of the suspended span. As the end web members of cantilever and suspended spans are parallel compression members, both of these sliding joints come where no strain exists.

The sliding joint in the bottom chord is shown in the drawings. It slides between polished steel surfaces with a play of only 1-32 in. This joint is placed near a floor-beam, and the lateral system of the cantilever arm ends at this floor-beam, which forms the lateral strut. The lateral system of the suspended span ends on the other side of the sliding joint, there being an independent strut to hold the two chords in position; this strut was put in after the erection of the superstructure, the pinholes being reamed in position. There is no observable lost motion at this joint. The top lateral strains are transferred at the ends of the suspended spans to the bottom chord by the portal bracing, and there is no lateral system in the top chord of the end panels of the suspended spans. The sliding joint in the top chord is made, therefore, simply an oblong pinhole between two sets of stiffened tension members. The same oblong pinhole was used in the bottom chord joint, but principally for necessities of erection.

The large expansion existing at the ends of the suspended spans made some special expansion arrangement necessary in the connection between the stringers and the floor beams. An ingenious arrangement to accomplish this end was designed by Mr. Ralph Modjeski, Assistant Engineer (Eng. News, Dec. 1, 1892). It dispenses entirely with a long sliding surface and supports the end of the stringer perfectly.

As the end of the anchorage arm consists only of tension members, it was difficult to make a satisfactory form of portal which would at once resist vibrations and have the substantial appearance which seemed important in the most conspicuous part of the bridge. The result was accomplished by making a stiff frame, entirely independent of the tension members, consisting of posts placed between the inclined eye-bars of the end panels, these posts being connected by a stiff strut at the center, and the rectangular panel above divided by stiff diagonals. This stiff frame is attached to the pins of the truss, but the pinholes in the stiff posts are made 1 in. larger than the diameters of the pins, so that the tensile strains should not be disturbed.

THE SUBSTRUCTURE OF THE SEVENTH AVENUE SWINGBRIDGE, NEW YORK CITY.

By W. Gustav Triest, Jun. Am. Soc. C. E.,
Assistant Engineer.

The Engineering News of May 26, 1892, contained a description of the Harlem River swingbridge at Seventh Ave., New York, for which the contract was let in the spring of last year. The two end rest piers and the pivot pier of the swing span are now completed and a description of them follows.

The width of the Harlem is 400 ft. between bulkheads, and the centers of the end rest piers are 415 ft. apart, providing for a swing span of two arms of 206 ft. 7 ins. each, or 413 ft. 2 ins. long over all. The last span of the Exterior St. approach rests on the west rest pier, and the deck girders of the Jerome Ave. approach commence at the east rest pier.

The West End Rest Pier.—Bedrock was found at the site of this pier at an elevation of 30 ft. below datum, M. H. W., overlaid by disintegrated rock, boulders, mud and filled ground. A pneumatic foundation was necessary.

The site of the pier and the area back of it were dredged to low water by a grapple dredge, and the caisson was erected on blocking on the dredged ground in the rear of its final position. The caisson is 100 ft. long, 19 ft. wide, 10 ft. high, giving a clear height of 7 ft. 9 ins. to the working chamber. The vertical sides consist of ½-in. plates, reinforced at the bottom by one 18 × ⅞-in. and one 9 × ½-in. plate to form the cutting edge. The roof is a ⅜-in. plate supported every 4 ft. by 20-in. I-beams, which run across the caisson. The sides are stiffened against the roof beams by stout corner brackets. The material is soft steel.

After completion the caisson was lowered by jackscrews to as near low water as practicable. At high water the air chamber was filled with compressed air and by its buoyancy the caisson was floated into position. No false bottom was used. The sinking progressed slowly on account of the troublesome material encountered and the irregularities of the rock bottom, which had to be cut down. After the cutting edge had reached the rock stratum, which was found to lie on its natural bed, the working chamber was filled with a concrete compound of Portland cement, sand and ½-in. stone in the ratios of 1 to 2 to 4. The steel caisson is surmounted by a cofferdam of 12 × 12 in. timber which was built up as the caisson went down. Its first course is bolted to the caisson, and the following courses are drift-bolted to the bottom course and held additionally by 60° rods secured to straps riveted to the steel shell.

Above street grade the pier consists of two pillars connected by an arch, underneath which stone steps lead to the level of the water (Fig. 1). The shafts of the pillars are battered 1½ ins. in 1 ft. and are surmounted by a necking, bell and coping course. From the ends of the coping rise houses for the bridge tenders. The pier is built of dark granite, while the dressed courses are light. The houses have red tile roofs. Fig. 2 gives views of the two end rest piers, which are alike above low water.

The Pivot Pier.—The borings showed rock at the site of the pivot pier at elevations varying between 18 and 26 ft. below datum, overlaid by a thin cover of silt. Here also a pneumatic foundation had to be resorted to. The original plans provided for a circular steel caisson with a roof supported by a number of parallel girders, but the contractors were afterward allowed to substitute an annular caisson with an outer steel shell and an inner octagonal wooden wall, with a view to pumping out the interior of the octagon and thus build the core of the pier in the open air. They expected to gain time by doing this, but unforeseen circumstances prevented this. Fig. 3 shows the caisson and a section through the completed pier.

The caisson was built on a level stretch of shore on blocking high enough to admit of constant working at all stages of the water. A false bottom was built in the octagonal interior. This bottom consisted of a grillage of 10 × 12-in. timbers about 4 ft. apart, to the underside of which a flooring of 3-in. plank was spiked. The timbers were shored from the top, the shores being so arranged as to be released from above by the pulling of wedges. Holes were drilled in the false bottom to permit a free entrance of the tidewater during the subsequent lowering of the caisson to low water. The holes were then plugged, the air chamber was filled with compressed air and, at a conveniently high tide, the caisson was floated and towed into position.

The false bottom was now removed and the caisson weighted down for sinking by a gradually imposed load of 600 tons of one man stones placed on the roof of the working chamber. The rock at the pier site had been previously leveled off by a number of sub-marine blastings, but the work was not found to be expedited much by it, as the debris had not been cleared away. The sinking did not present any particular difficulties, but proceeded naturally slowly on account of the work caused by the double cutting edge, the narrowness of the annular chamber not permitting very expeditious working.

At an elevation of 26 ft. below M. H. W. the cutting edge reached bedrock, which at this point of the river was found to be upheaved on edge and full of fissures. The rock over the whole area of the working chamber was exposed and cleaned off. To do this it was necessary in many places to dig more or less below the cutting edge in order to clean out fissures of sand and rotten rock. A layer of concrete was deposited and rammed in the working chamber, reaching everywhere 2 ft. above the cutting edge. This concrete consisted of 1 part of Portland cement, 2 parts of sand and 3 parts of ½-in. trap rock.

In the rest of the chamber the air pressure was maintained, and an attempt was made to pump out the octagonal interior with two 6-in. centrifugal pumps. The pumping was not successful. The commotion of the water inside of the water-filled octagon indicated where water found entrance through fissures of the rock. The 2-ft. layer of con-

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF JULY, 1893.

[Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain and melted snow—inches.		
		Average	Max.	Min.	Range.	Velocity in miles per hour. Average	Velocity in miles per hour. Max.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	63.8	86	41	45	7.9	40	SW	3.74	0.81	14
	Portland, Me.	68.3	93	53	40	7.5	32	W	0.96	0.28	8
	New York, N. Y.	74.8	93	56	37	9.5	36	SW	1.26	0.51	9
	Pittsburg, Pa.	73.7	95	53	42	5.5	26	NE	5.08	1.29	12
	Chicago, Ill.	73.8	94	60	34	14.1	40	S	3.08	1.14	6
	Omaha, Neb.	76.6	97	60	37	6.7	36	NW	3.03	1.39	7
	St. Paul, Minn.	73.4	98	56	42	6.3	26	W	1.68	1.08	8
	Duluth, Minn.	66.3	93	48	45	5.7	20	NW	3.76	1.18	10
	Bismarck, N. Dak.	70.2	98	50	48	8.8	40	NW	1.48	0.60	9
	Average	71.2	94	53	41	8.0	33		2.67	0.92	9
Southern Cities.	Washington, D. C.	77.0	97	57	40	5.4	36	W	1.44	0.45	11
	Louisville, Ky.	80.8	97	64	33	6.4	46	NW	1.52	0.65	8
	St. Louis, Mo.	80.2	94	67	27	9.7	50	NW	2.49	1.03	10
	Savannah, Ga.	83.0	100	69	31	6.8	38	NW	4.63	1.62	12
	Leavenworth, Kan.	78.0	96	62	34	7.9	48	SW	6.92	1.75	10
	Jacksonville, Fla.	83.6	100	68	32	6.3	36	SE	4.54	1.81	12
	Chattanooga, Tenn.	80.5	98	65	33	5.7	38	W	1.24	0.26	16
	New Orleans, La.	83.1	94	73	21	5.9	25	N	3.72	1.04	12
	Memphis, Tenn.	82.0	97	68	29	5.6	35	NW	0.73	0.19	9
	Palestine, Tex.	83.5	100	70	30	4.9	20	SE	0.09	0.09	1
	Average	81.2	97	66	31	6.5	37		2.73	0.89	10
Western Cities.	Helena, Mont.	69.5	102	47	55	8.5	40	SW	0.86	0.55	7
	Port Angeles, Wash.	55.8	76	42	34	7.3	24	W	0.24	0.14	5
	San Francisco, Cal.	56.6	74	47	27	15.3	37	SW	0.02	0.02	1
	Salt Lake City, Utah	74.7	99	52	47	6.1	30	SW	1.19	0.77	2
	Denver, Colo.	73.4	96	54	42	6.7	36	SE	1.14	0.44	8
	Yuma, Ariz.	90.3	109	70	39	6.9	38	E	0.50	0.45	2
	Santa Fé, N. Mex.	68.6	89	54	35	6.7	36	SW	3.01	0.91	18
	Average	69.8	92	52	40	8.2	34		0.99	0.47	6

crete in the chamber was cut out at those places and the attempt made to seal the fissures. A second trial of pumping was then made with two 6-in. and one 9-in. centrifugal pumps, but likewise without success.

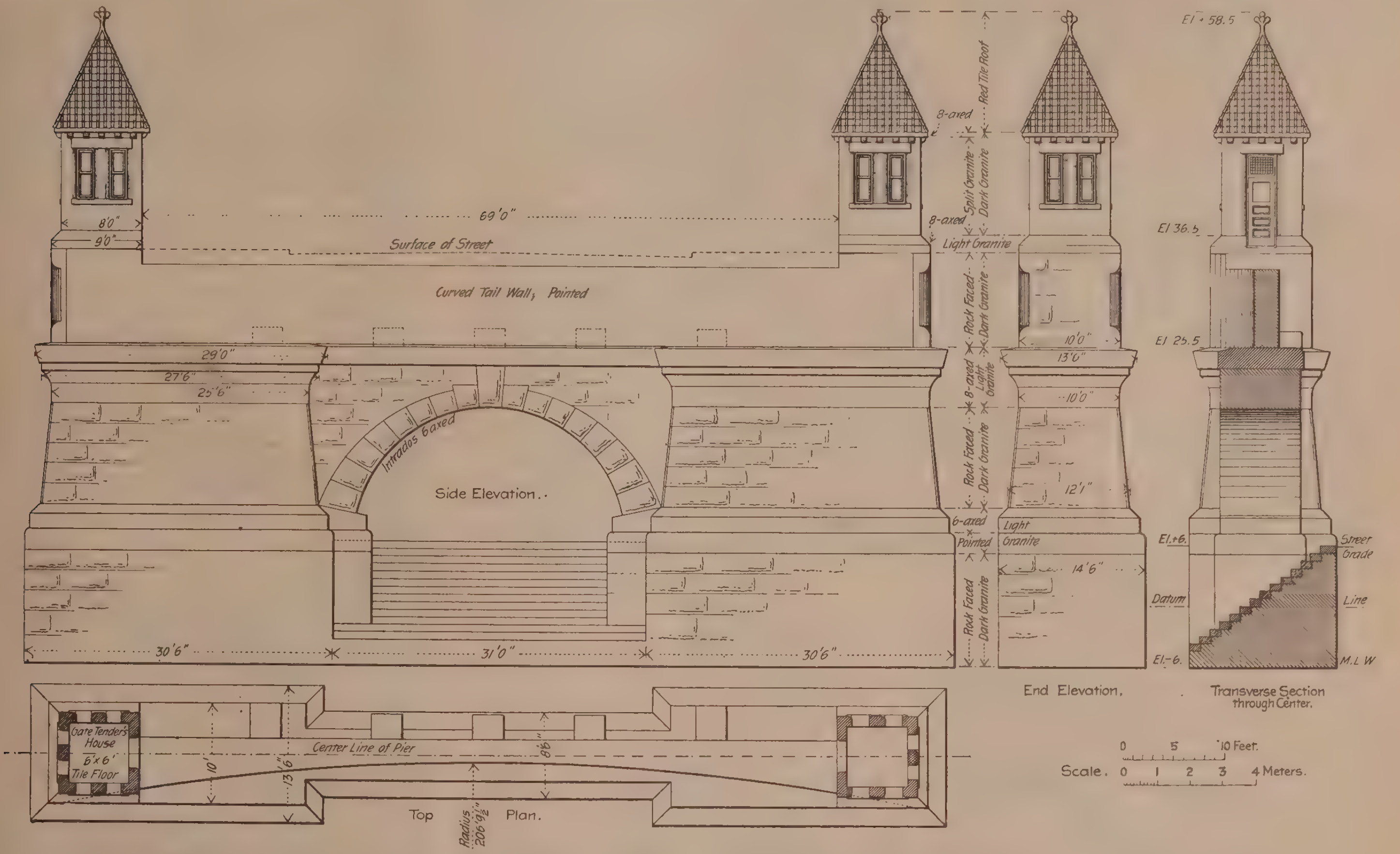


FIG 1. END REST PIER FOR 7TH AVE. SWING BRIDGE. ALFRED P. BOLLER, CHIEF ENGINEER. Steward & McDermott, Contractors.

It was now decided to concrete the interior below water. Several barge loads of swamp silt had been deposited along the exterior edge of the octagon to prevent leakage of the compressed air. This silt was jetted by a diver and partly pumped out and partly taken out by a grapple dredge. The concrete, which consisted of 1 part of Portland cement, 2 parts of sand and 4 parts of 1-in. stone, was lowered into the water in wooden buckets of 22 cu. ft. contents. The buckets were triangular in one vertical section with one perpendicular side which, when tripped from above, swung open around a horizontal hinge. Seven feet of concrete were thus uniformly deposited over the bottom of the interior.

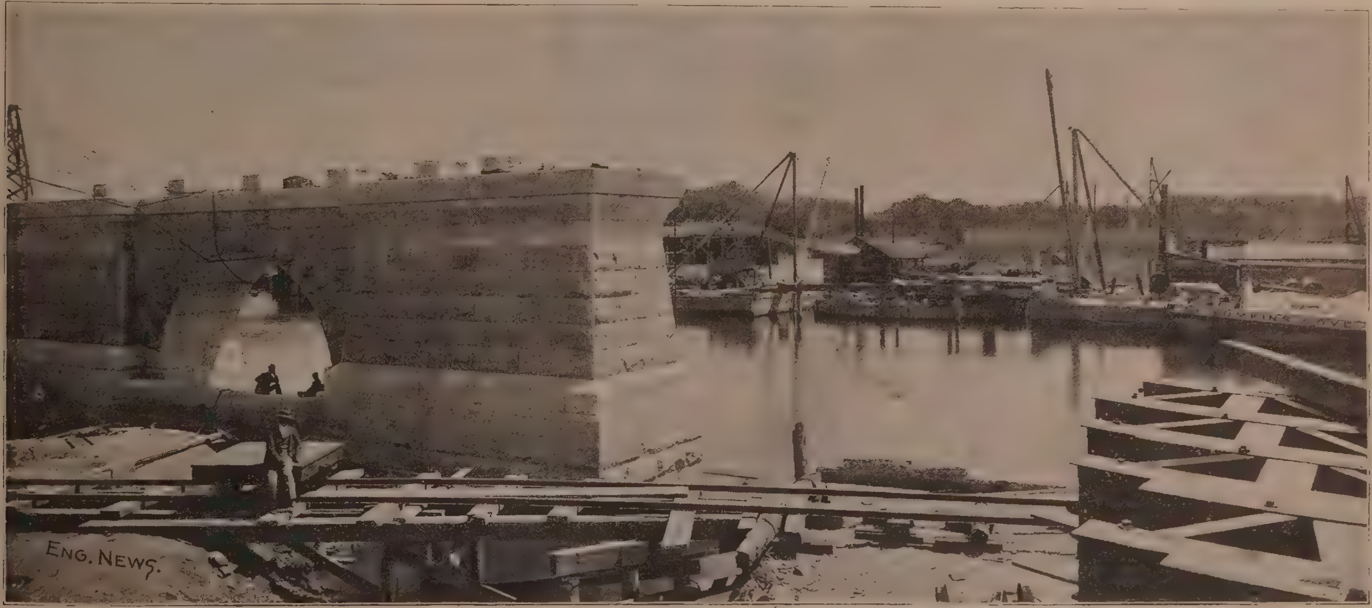


FIG. 2. VIEW OF MASONRY SUBSTRUCTURE IN PROCESS OF CONSTRUCTION. East End Rest Pier in Left Foreground.

The concrete was given 14 days for setting under water, during which time the working chamber was filled to within 10 ins. from the roof. After the lapse of this period the interior was pumped dry and the ballast stones were removed from the roof of the chamber. The wooden verticals were sawed off and the roof of the chamber was cut out. The pier was carried up in Portland cement concrete to 11 ft. below datum, the concrete laid in the open air forming a perfect union with the concrete of the working chamber and with the concrete which had been deposited under water.

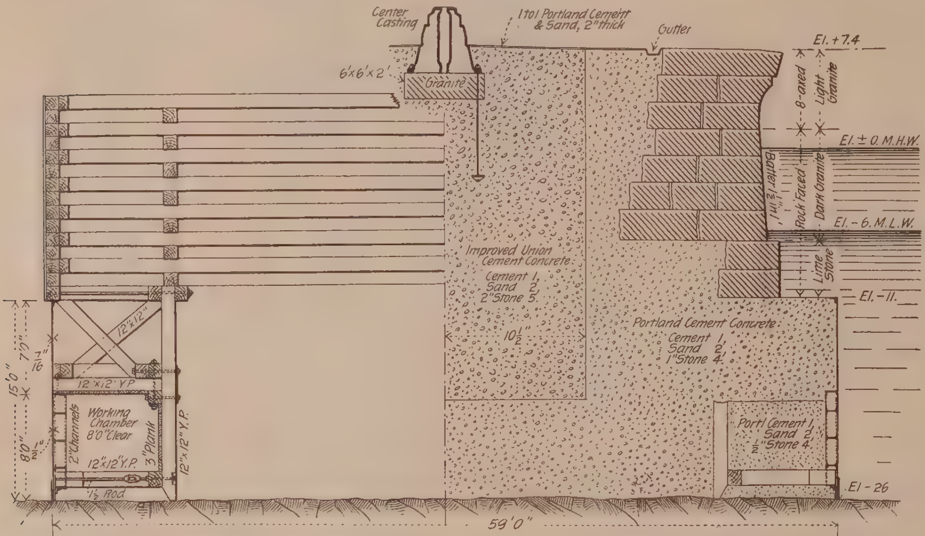
Above the concrete two courses of Sandy Hill limestone are laid, from which at an offset the battered shaft of the pier rises. A necking, bell and coping course finish the pier. The battered course and the neck are faced with dark Maine granite, backed by limestone. The dressed courses are of the light Mt. Waldo granite.

In the heart of the pier an octagon of 21 ft. inner diameter is built of Improved Union concrete on top of the concrete laid under water. A portion of the ballast stone was incorporated into this prism. Particular attention was bestowed on the setting and leveling of the coping, which is to give an even bearing to the tracks of the two concentric sets of rollers which support the double drum.

The East End Rest Pier.—The foundation of the east end pier was built in a cofferdam 24 × 100 ft. inside dimensions. The gneiss rock, though pitching off from an elevation of 28 ft., 8 ins. in the length of the pier was on its natural bed. On top of the gneiss were found heavy trap rock boulders overlaid by peat and mud in about equal thicknesses. Little or no sand covered the rock excepting at the deep end, where the only difficulty in pumping was experienced. At that point the sand was drawn by the pumps from under the edge of the sheet piling in large quantities and caused an adjoining platform to settle several feet. The excavation was carried down uniformly to the highest point of the rock and advanced afterward in sections of 10-ft. lengths to the deep end.

The cofferdam consists of 12 × 12-in. sheet piling. To the timber planed strips 3¼ × 2½ ins. were spiked, forming a tongue and groove. The sheet piling was driven in single lengths by blows of an 1,800-lb. hammer so as to just touch the rock.

Fig. 2 gives a general view of the building site. The western end rest pier shows in the foreground completed up to the houses. In the river the cofferdam for the pivot pier rises a few feet above the water, flanked by the heavy fender stone cribs. In the rear appears the eastern end rest pier, to the left of which the engine-house for the pneumatic work is visible.



Half Cross Section through Caisson & Cofferdam.

Half Cross Section through Completed Pier.

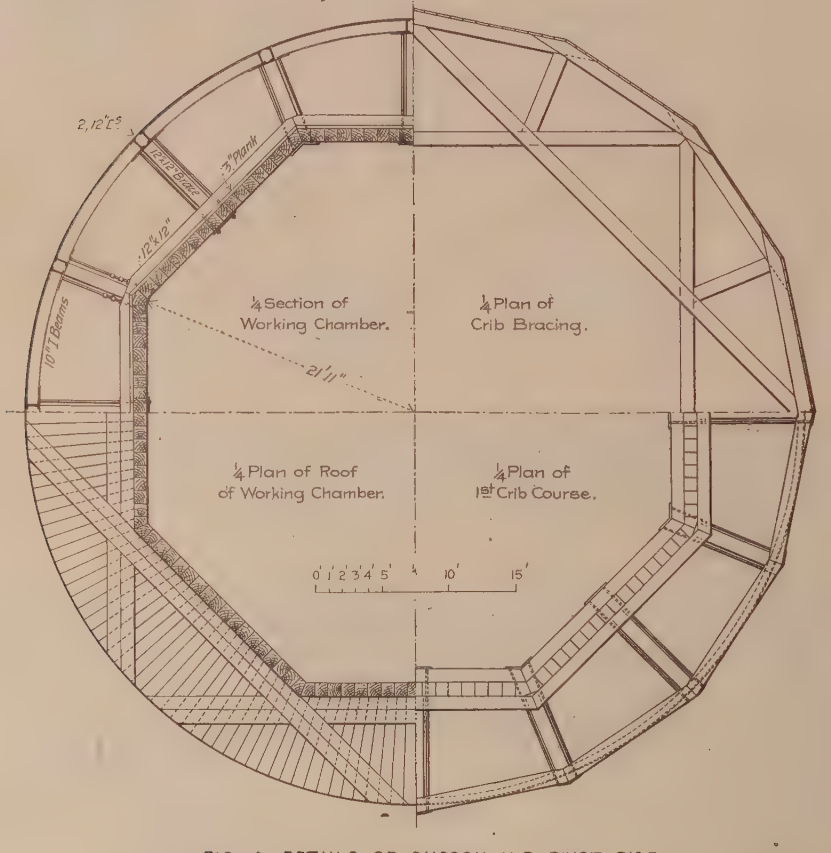


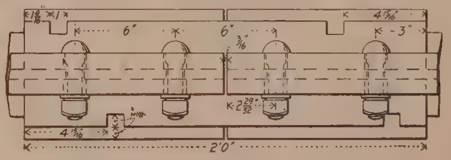
FIG. 3. DETAILS OF CAISSON AND PIVOT PIER.

Mr. Alfred P. Boller, M. Am. Soc. C. E., is the Chief Engineer, and Mr. Martin Gay, M. Am. Soc. C. E., is Resident Engineer. The contractors for the masonry are Steward & McDermott. The pneumatic work has been done by Sooysmith & Co. under the superintendence of Mr. Geo. E. Thomas and of Mr. C. C. Lovejoy.

BRIDGE JOINT FOR 80-LB. RAIL; CHICAGO & NORTHWESTERN RY.

In discussing the question of rail joints we have frequently pointed out the advantages of giving a base support to the rail ends, and the best results with such an arrangement appear to be obtained when the base plate is of sufficient length to rest upon the two joint ties, thus forming a bridge to carry the rail ends of a suspended joint. During a recent trip over the Chicago & Northwestern Ry. from Milwaukee to Chicago, we particularly noticed the excellence of the track and its smooth riding qualities, due partly to the use of heavy rails, and partly to the use of the bridge joint, of which we present drawings herewith. The road is double-tracked for the greater part of the distance between Chicago and Milwaukee, and the work of double-tracking is in progress on the other part. The joint was designed by Mr. John E. Blunt, Chief Engineer, and approved as the standard joint in February, 1892, by Mr. S. Sanborn, General Superintendent, and Mr. J. M. Whitman, General Manager.

The rails weigh 80 lbs. per yd., and are spliced by angle bars 24 ins. long, with four bolts. The base plate or bridge plate is also 24 ins. long, and the shoulder ties upon which it rests are about 8 ins. apart in the clear. There are four spikes to each joint, but probably greater efficiency and less wear would result from the use of a more secure fastening, such as the lag screws for angle bars in the specimen track of the Pennsylvania R. R., at the World's Columbian Exposition, as noted in another column of this issue. The plate is 7¾ ins. wide, with a 5⅛-in. seat for the rail, the thickness being ⅜-in. under the rail and ⅝-in. at the edges. The joint bolts are spaced 6 ins. c. to c., and have necks of a rather unusual form, as shown. They are ⅞ in. diameter, with cup heads 1⅝ ins. diameter, and necks ⅞ × 1 3-16 ins. The nuts are 1 7-16 ins. square, fitted with spring washers. On the same division of this road a part of the track is laid with six-bolt angle bars and three-tie joints, and long angle bars with four bolts were also noticed. The rails are laid with square joints.



Plan of Bridge Joint for 80-lb. Rail; C. & N. W. Ry.

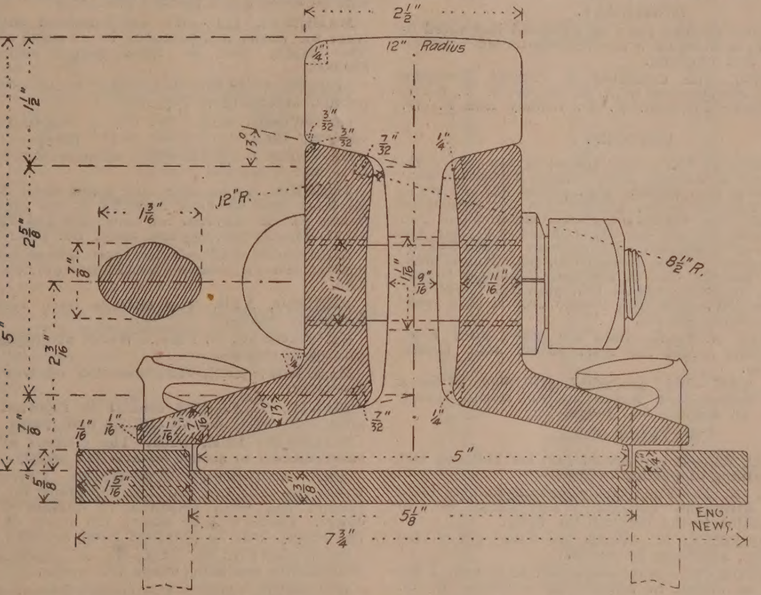
The 80-lb. rails are almost identical with the section of this weight presented by the committee of the American Society of Civil Engineers (Eng. News, Aug. 17). The only variations are that the radius of the top corner of the head is ¼ in. instead of 5-16 in., as in the Am. Soc. C. E. standard, the bottom corner is 3-32 in. instead of 1-16 in., and the web is 1-64 in. thicker.

A projected canal from Marseilles to the valley of the Rhone is attracting the attention of French engineers, and they are at present engaged in seeking an outlet on the Mediterranean coast. This scheme would place a port which absorbs one-third of French commerce in communication with the canal and river systems of the Continent.

The Southern Pacific Railway Company is having a rather novel problem of stream diversions to deal with at Wright's Station, in the Santa Cruz mountains. A landslide filled up the bed of a canyon so that it is now 5 or 6 ft. higher than the railway track instead of being several feet lower. Estimates show that it would cost too much to remove the earth, and the engineers have determined to prolong the adjoining tunnel and carry the stream over the railway in a strong masonry conduit. To do this they will have to fill in the stream bed for several hundred feet so as to sufficiently raise the level of the water.

A patent fuel manufactured from bituminous slack coal is being exploited under the name of "eggete coal," the lumps produced being about the size and shape of a hen's egg. The slack is mixed with a binding material, the composition of which is not made public, and the resulting stiff, doughy mass is passed between heavy iron rollers with hollows in their surfaces having the form of half eggs. The machine is, in fact, a copy, on a large scale, of a confectioner's lemon drop machine. Tests of this fuel by Prof. J. E. Denton, of Stevens Institute, showed a thermal value per pound nearly 10% in excess of chestnut anthracite. The great fault of fuels of this class has been a tendency to melt into a uniform sticky mass which the air cannot penetrate, and even those which did well in an ordinary fire have succumbed to the intense heat of a furnace. We understand that the eggete fuel, however, will hold its form in the hottest fire, and burns as freely with the intense heat of a forced draft as good coal. The process of manufacture of the eggetes is inexpensive, and the new fuel has already achieved, we understand, considerable commercial success. The process is controlled by the Fuel Patents Co., of 220 South Third St., Philadelphia, and the National Eggette Coal Co., of Milwaukee, Wis.

The American Asphalt Co., of Colorado, says the Washington "Star," has had its lease on 5,000 acres of asphalt lands, in the Uintah Indian Reservation in Utah, approved by the Secretary of the Interior on Aug. 24. Under the terms of the lease the company can locate in three different parts of the reservation, but whenever these lands are opened to settlement the lease should immediately terminate. The consideration is $1 per ton for all asphalt mined, and this may be increased to $2.50 in the discretion of the Secretary. For other minerals incidentally mined a royalty of 15% is to be paid.



SECTION OF 80-LB RAIL AND BRIDGE JOINT ; CHICAGO & NORTHWESTERN RAILWAY.

The locomotives of the new Lake St. Elevated Ry., at Chicago, are all of the two-cylinder system of the Rhode Island Locomotive Works, Providence, R. I., which has already been described in our columns. The engines are of the usual type for elevated railway service, having four driving wheels under the boiler and a four-wheel trailing truck under the tank. They work as simple engines in starting by an automatic valve which admits live steam into the low pressure cylinder until the pressure reaches a given limit in the receiver. The simple working can be continued as long as desired. The general dimensions of these engines are as follows:

Driving wheels, diam	3 ft. 8 ins.
Truck wheels. diam	2 " 4 "
Wheel base, driving	5 " 0 "
" " truck	4 " 8 "
" " total	16 " 1 "
Weight, on drivers	43,000 lbs.
" on truck	17,000 "
" total	60,000 "
Cylinders, h. p.	13 × 18 ins.
" l. p.	21 × 18 "
" distance c. to c.	6 ft. 4 ins.
Boiler, wagon top, diam. of barrel	3 ft. 8⅝ ins.
Boiler, thickness of barrel plates	7/16 in.
Firebox, radial stay	4 ft. 10 ins. × 3 ft. 6⅝ ins.
" tube plate	7/16 in.
" other plates	5/16 in.
Tubes, 188 ; diam	1½ ins.
" length	6 ft. 6 ins.
Boiler pressure	180 lbs.
Fuel	Anthracite.

Reports of some extended tests of cements have been sent us by Mr. G. M. Ames, Asst. City Engineer of Grand Rapids, Mich. The tests apparently show that the American Rosendale cements, of which four different brands were tested, show considerably greater strength if the briquette is thoroughly dried before testing. The Portland cements, on the contrary, showed invariably a loss of strength where the briquette was dried before testing. The Portland cements were mixed neat, while the other cements were mixed with sand. Mr. Ames inquires whether any other of our readers have observed a similar variation in testing cement or can offer an explanation of its cause.

CONSTRUCTION NEWS

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & OHIO.—A report from Baltimore states that this company will build the proposed line to connect its metropolitan branch with the Richmond & Danville road as soon as the financial stringency is over. The line is graded to Rock Creek, near Washington, and is to extend from Linden Station to Fairfax, Va., a distance of 15 miles.——The grading of the extension from Wooster to Millersburg, O., is reported as about completed to within four miles of Millersburg, where it meets the Cleveland, Akron & Columbus road. It is further stated that the C., A. & C. road will be double-tracked these four miles, and that the work will be completed by the middle of this month.

BUFFALO, ROCHESTER & PITTSBURG.—The extension of this road a distance of about 26 miles south from near Bradford, Pa., has been completed and opened for traffic. Formerly trains went over the Erie tracks and the Kinzua bridge, and the new route obviates the necessity of crossing the bridge.——Work is also about completed upon the Clearfield & Mahoning branch, 27 miles long, to Clearfield, Pa. By means of this line and the Beach Creek road a connection is now made with the Philadelphia & Reading, and the product of the coal mines near Dubois, Pa., which was formerly sent north will hereafter have a direct Eastern outlet.

CHICAGO, INDIANA & EASTERN.—The construction of this railway was commenced near Fairmount, Ind., Aug. 18. The road is proposed to extend from Chicago to Columbus, O., and the contract for the section from Fairmount to Muncie, Ind., 26½ miles, has been awarded to Schafer, Nichols & Watkins Co., Louisville, Ky., as noted in our issue of June 29. Pres., F. A. Root; Ch. Engr., D. G. Seymour, Fairmount, Ind.

ELKHART & WESTERN.—This road has been completed from Elkhart to Mishawaka, Ind., where it connects with the Chicago & Grand Trunk road. The line is projected from Elkhart to South Bend, a distance of 16 miles. E. C. Bickel, Gen. Man., Elkhart, Ind.

NEW YORK, NEW HAVEN & HARTFORD.—A report from New Haven, Conn., states that the tunnel on this road, about two miles from that city, is expected to be completed by next April. It will be between 500 and 600 ft. long, and the four miles of new road being built will shorten the route by over a mile. J. K. Ryan, New York, is the contractor.

PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS.—On the extension from New Cumberland, W. Va., to East Liverpool, O., grading has been completed from New Cumberland to Porters, and track has been laid to Kennowith, according to reports.——It is reported that a branch line will be built in Indiana from Gas City to Frankton, by way of Fairmount.

PITTSBURG, FORT WAYNE & CHICAGO.—Plans have been submitted to the city of Chicago by this company for the elevation of its tracks in the south part of the city. The plans include about four miles of four-track elevated road, the work to be completed in three years.

Projects and Surveys.

MICHIGAN.—A press dispatch from Battle Creek states that Jerry Boynton is pushing a project for a railway from Hastings to that city, through Fillport, Grand Rapids, Grand Haven, Johnston and Bedford.

PITTSBURG & MANSFIELD.—This company has been incorporated in Pennsylvania to build a railway from Water St., Pittsburg, to Mansfield, a distance of four miles, tunneling under Mount Washington. Pres., Elliott Holbrook; Secy., C. J. McDonald; Treas., Wm. Roseburg; Ch. Engr., E. K. Morse, all of Pittsburg, Pa.

WISCASSET & QUEBEC.—Geo. H. Crosby, Albion, Me., has made an agreement to begin the construction of this road when $50,000 of the capital stock has been subscribed. The town of Wiscasset, the proposed southern terminus, has voted a large subsidy in aid of the road, and other towns will probably also vote to aid the project. The line is to begin at tidewater in Wiscasset, and extend through Alna, Whitefield, Windsor, China, Albion and Unity to Burnham station, where it will connect with the Maine Central road, a total distance of about 50 miles. The work of surveying the route will be commenced at once. Pres. and Gen. Man., Geo. H. Crosby; Treas., Wm. D. Patterson, Wiscasset, Me.

Southern—Existing Roads.

EAST TENNESSEE, VIRGINIA & GEORGIA.—The extension of the Mobile & Birmingham road, three miles long, through One Mile Swamp and over Three Mile Creek has been completed. The company has heretofore used the Mobile & Ohio road to reach its main track.

MIDDLE GEORGIA & ATLANTIC.—It is reported that this company will operate the line between Milledgeville and Eatonton, Ga., after Sept. 11, and run through trains from Covington, Ga., to Milledgeville. The five miles of unfinished road near Covington will be completed at once. Arthur Pew, Ch. Engr., Talbotton, Ga.

Projects and Surveys.

RONCEVERTE & LEWISBURG.—It is reported that this road will be built between Ronceverte and Lewisburg, W. Va., as soon as each of the two cities subscribe $15,000 to the capital stock. J. H. Price, Ronceverte, W. Va.

Northwest—Existing Roads.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—The extension from Ponca to New Castle, Neb., about 15 miles long, has been opened for traffic.

GREAT NORTHERN.—A press report from Yankton, S. Dak., states as follows: It is asserted by projectors of the Yankton & Norfolk Ry. that 18 miles of this roadbed have been sold to the Great Northern, and the contractors now constructing the Sioux Falls-Yankton extension of the latter road expect to begin ironing the new acquisition by Sept. 5. The purchase of only 18 miles of the Yankton & Norfolk roadbed is interpreted to mean that James J. Hill intends extending his road in a more southerly direction to connect with the Missouri Pacific. The Great Northern extension from Sioux Falls will be completed to Yankton this week. It is understood that Senator Pettigrew has transferred his franchise for a railway bridge across the Missouri River to J. J. Hill, and that Yankton is to be made division headquarters for the Great Northern.

ST. LOUIS, CHICAGO & ST. PAUL.—Work has been temporarily suspended on the extensions from Alton to Kinders, Ill., and from Loami to Springfield, Ill., owing to the stringency of the money market, says the "Railway Age." The extension from Loami to Springfield, 14 miles, is completed, with the exception of about half a mile in the city of Springfield. The extension from Alton to Kinders, 15 miles, is graded ready for tracklaying. F. P. Read, Springfield, Ill., has succeeded E. M. Rice as chief engineer.

Projects and Surveys.

CHICAGO, SUPERIOR & PACIFIC.—A charter for this road has been granted to W. R. Chadsey, New York. This is the original Wisconsin Central, chartered in 1853, upon which nearly $3,000,000 has been expended from the Illinois state line northwesterly to Superior. It is stated that the construction will be undertaken by a foreign syndicate, and that the intention is to connect Duluth, Superior and St. Paul with the Wabash line to Detroit at Chicago. The move is supposed to be in the interest of the Canadian lines, probably the Canadian Pacific.

ILLINOIS.—Milton C. Brown is reported as organizing a company to build a railway from East St. Louis to Cairo, Ill. The proposed route is said to be 20 miles distant from any other railway.

WAUKEGAN & MISSISSIPPI VALLEY.—Incorporated in Illinois to build a railway from Waukegan to Cuba, Wauconda and Grant, with branches to Shields and Benton townships, all in Lake county; capital stock $60,000 (or $600,000); directors, C. S. Holt, C. H. Hamill, Wm. P. Sidley, Wm. J. Louderback and Arthur Wheeler, all of Chicago; principal offices at Waukegan, Ill.

Southwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—A short section will be built at Fort Worth, Tex., to connect with the Houston & Texas Central, for the purpose of a general interchange of traffic.

KANSAS CITY, PITTSBURG & GULF.—E. L. Martin, Pres., Kansas City, Mo., writes us that the extension between Pittsburg, Kan., and Joplin, Mo., a distance of 25 miles, was expected to be completed by Sept. 1. The extension from Sulphur Springs, Ark., to Siloam Springs, Ark., 25 miles, is expected to be completed by Nov. 1, and that between Hume, Mo., and Pittsburg, Kan., 50 miles, was completed June 1; which, when the line is completed to Siloam Springs, will make a total construction this year of 125 miles. This mileage may be increased during the fall and winter.

MISSOURI, KANSAS & TEXAS.—Location has been completed and surveys made for an extension of this line from Paola, Kan., to Kansas City, 43 miles. Another extension has been located from Holden to Warrensburg, Mo., 18 miles, on the projected line from Holden to Boonville, Mo., 70 miles. A report from San Antonio, Tex., states that officials of this road have been in the city with a view to an extension also from San Marcus to that city, a distance of 50 miles.

TEXAS, LOUISIANA & EASTERN.—Tracklaying will soon be resumed on the section of about eight miles east of Cleveland, Tex., which is now graded, according to reports. The rails have now been laid from Conroe, Tex., about 30 miles beyond Cleveland station, where connection is made with the Houston, East & West Texas road.

Projects and Surveys.

BISMARCK & GALVESTON.—The Farmer's Alliance project, to which we have made occasional reference under this heading, has reached the state of incorporation. A charter was granted in Kansas Aug. 31 for a railway from Running Water, S. Dak., to the Gulf of Mexico; capital stock, $18,000,000. This is the outgrowth of the recent convention held at Lincoln, Neb. It is proposed to ship the products of the Mississippi Valley to Europe by way of the Gulf of Mexico, and the states to be benefited by the proposed railway will be asked to contribute to its construction. Edward Romer, New York, is named as an incorporator.

Rocky Mt. and Pacific—Existing Roads.

COLORADO MIDLAND.—B. H. Bryant, Supt. and Ch. Engr., Colorado Springs, has taken charge of the construction of the Busk-Ivanhoe tunnel, the contract for which was awarded to M. H. Keefe, Helena, Mont., at $1,000,000. Mr. Keefe completed, in about three years, 8,478 ft. of the total 9,393 ft. and voluntarily surrendered the work because of ill health, according to reports. Aug. 15 Mr. Bryant had reduced the distance between headings to 644 ft. W. H. Leffingwell is resident engineer in charge of the work.

COOS BAY, ROSEBURG & EASTERN.—This railway has been completed from Marshfield to Myrtle Point, Ore., a distance of 26½ miles, according to reports from Marshfield, Ore., and surveyors are now laying out the work on the next section of the road to Angora. W. Z. Earle, Ch. Engr., Marshfield, Ore.

PAJARO VALLEY.—A report from Santa Cruz states that Chas. Spreckles has ordered that a survey be made for an extension of his narrow gage railway way from Watsonville to Coralitos, Cal.

STREET RAILWAYS.

BRAINTREE, MASS.—Geo. A. Beatey, Treas., Braintree, Randolph & Holbrook St. Ry. Co., is receiving subscriptions for the stock of the company. Each of the three named towns has granted a franchise for the proposed road.

MELROSE, MASS.—The selectmen have granted the Lynn & Boston St. R. R. Co. the right to complete its lines from Melrose Highlands to the Wakefield line. This will make a direct street railway between Wakefield and Boston over three roads.

KINGSTON, N. Y.—It is reported that a franchise has been granted to a new company, and that the construction of the road will be commenced this month.

STILLWATER, N. Y.—The Stillwater & Mechanicville St. R. R. Co. has increased its capital stock from $40,000 to $60,000, and will commence reconstructing its track about Sept. 15 so as to use electric motive power.

BRIDGETON, N. J.—The South Jersey Traction Co. has been granted the privilege of stringing trolley wires on any street in the city, according to reports.

CAMDEN, N. J.—The West Jersey Traction Co. has secured the franchise of the Haddonfield turnpike, upon which to lay tracks from the outskirts of this city to Haddonfield. Efforts will be renewed by the company for the privilege of crossing one of the bridges across Cooper's Creek into this place.

LANCASTER, PA.—Col. S. C. Slaymaker and a corps of engineers have commenced the survey of the new electric railway over the Lititz, Manheim and Conestoga Valley lines. The survey of the proposed routes will be hurried forward as quickly as possible.

PENN ARGYL, PA.—It is reported that the contract for an electric railway between this place and East Bangor has been awarded to the Pierce & Miller Engineering Co., New York, and that the construction will soon be commenced. H. R. Fehr, Easton, has charge of the engineering corps.

WEST FAIRVIEW, PA.—It is stated that the construction of the West Fairview & Harrisburg Electric Ry. will be commenced this month.

BALTIMORE, MD.—Oden Bowie, Pres. City Passenger Ry. Co., has been authorized to receive bids for building the electric power-house and car shops for the company at Light and Marshall Sts. The building will be 168 x 200 ft., and contracts are reported as having been already awarded for three 100-HP. engines.

WASHINGTON, D. C.—The Washington Traction Co. has been organized by E. W. Rollins, E. O. McNeil, S. W. Curriden, J. R. Baldwin and others to build a street railway in this city. The motor power to be used is the underground electric system, such as in present use in the U St. branch of the Rock Creek Ry., while the overhead trolley may be used upon that part of the route northwest of Rock Creek until the territory is built up and the district commissioners deem it proper to have the wires placed under ground; capital stock, $1,000,000.

MOUNDSVILLE, W. VA.—C. C. Smith is laying out the proposed route for the Benwood Southern Electric Ry. Co., noted in our issue of Aug. 17 as incorporated.

FOSTORIA, O.—It is reported that work will soon be resumed on the Tiffin & Fostoria Electric Ry., and that it will be pushed to completion as rapidly as possible.

NORTH BALTIMORE, O.—J. J. Geghan is interested in a proposed electric railway between this place and Welker.

YELLOW SPRINGS, O.—The commissioners of Green county have granted to Wayne Neff, Cincinnati, the right of way for an electric railway through the county. Mr. Neff has now the entire right of way from Springfield to Xenia, according to reports, the commissioners of Clarke Co. and the council of this place having granted him the privilege some weeks ago. The length of the road will be 18 miles. Between Springfield and Xenia it will run through Beattys, Husted, Stringtown, Yellow Springs, Goe's Station, Oldtown and the fair grounds. The power-house will be located in this city, which is midway between the terminals. The people along the route are reported as much pleased with the project.

MUNCIE, IND.—The council has granted a franchise to the Citizens' St. Ry. Co. The franchise is for 35 years and covers nearly every street in the city. The new company is a consolidation of the motor and electric lines; capital stock, $300,000.

MONROE, MICH.—J. H. Dawson, Toledo, H. H. Johnson, Philadelphia, and H. J. Warner, Brooklyn, were in the city last week making arrangements for an electric railway, which will run over the old plank road from Toledo to Detroit. The right of way from Toledo to the state line has been obtained.

SAGINAW, MICH.—Application will soon be made to the council, according to reports, for important extensions of the lines of the Saginaw Union St. R. R. Co.

CANTON, ILL.—A franchise for a street railway has been granted to Col. J. M. Snyder.——The Canton City Ry. Co. has been incorporated; capital stock, $100,000.

MUSCATINE, IA.—T. L. Seevers, Man., is reported as stating that the line will be extended to Musserville as soon as the necessary financial arrangements can be made.

KANSAS CITY, MO.—It is reported that a franchise has been granted to F. O. Hadley and W. E. Winner for an electric railway on East Fifteenth St., from the end of the cable line to the Blue River, by way of Manchester and Centropolis, manufacturing suburbs of the city. The applicants are owners of a tract of 100 acres on the Blue River lying on the route of the proposed line. This tract they say they intend to convert into a park.

CACOUNA, QUE.—A. J. Corriveau, Montreal, is interested in a proposed electric railway between this place and River du Loup.

QUEBEC, QUE.—The directors of the Quebec Central Ry. have decided to build an extension in the direction of Lake Megantic.

BRANTFORD, ONT.—H. P. Dwight and Frank Nichol, of Toronto, have been in the city with a view to extending the electric railway to Terrace Hill, a distance of about two miles.

LONDON, ONT.—The London West council has granted an exclusive franchise to the London St. Ry. Co. for an electric railway. The road will be constructed at once.

PORT HOPE, ONT.—It is reported that an electric railway is proposed to Cobourg, power to be furnished by the Port Hope Electric Light Co.

CAIRO, EGYPT.—The minister of public works will receive bids until Feb. 1, 1894, for a franchise for an electric railway in that city.

HIGHWAYS.

CONNECTICUT.—The town of Griswold has voted to spend $15,000 in building a macadamized road between Jewett City and Pachaug.

TENNESSEE.—The Columbia & Pulaski Turnpike Co. has been incorporated by J. M. Mayes, J. W. Frierson, Jr., Meade Frierson, E. D. Looney and S. W. Warfield.

BRIDGES.

INDIANAPOLIS, IND.—The following bids were received for the Kentucky Ave. bridge: Substructure—William Fife & Co., $29,409 with piling, $29,639 without piling; Koss & Fritz, $29,900 and $29,409; Enos Hedge, $30,967 and $26,687; Thomas Cummings & Co., $37,000. Superstructure—M. M. Defrees, $44,600; Variety Iron Works, $37,500 without steel joints, $40,483 with steel joints; Toledo Bridge Co., plan No. 1, $48,365; No. 2, $43,875; No. 3, $46,720; Pittsburg Bridge Co., $44,200; Massillon Bridge Co., plan No. 1, $41,720; No. 2, $45,890; Wrought Iron Bridge Co., 35 bids ranging from $25,400 to $89,113.

DICKINSON, N. DAK.—Bids are asked until Sept. 18 for a bridge across the Hart River. John Leask. Aud. Stark Co.

ORANGE, TEX.—Bids are asked until Sept. 22 for a drawbridge across Cow Bayou at the Round Bunch crossing. J. G. Burton, Co. Judge.

WATER-WORKS.

GUILFORD, ME.—It is reported that David Straw and others are talking of putting in works.

LACONIA, N. H.—The county commissioners have contracted with the Laconia Water-Works Co. to extend its mains to the Belknap Co. farm.

NEWMARKET, N. H.—Works are being put in for fire protection, according to reports.

BURLINGTON, VT.—Bids are asked until Oct. 7 for extensions, as stated in advertising columns. F. H. Crandall, Supt.

EAST BARRE, VT.—The supreme court has dissolved the injunction against the East Barre Water Co., and the works will now be completed.

WHITE RIVER JUNCTION, VT.—Joel Foster, Montpelier, has been making surveys for proposed works.

NEWBURYPORT, MASS.—The citizens voted, 1,266 to 362, against buying the works, and it is thought that an election will soon be held to vote on the question of constructing new works.

NORTH ANDOVER, MASS.—By a vote of 147 to 25 the town has voted to accept the franchise granted it to secure a supply.

SOUTH FRAMINGHAM, MASS.—Adjutant-General Dalton has seized the waters of Learned's Pond, for a supply for the state camp ground.

SPRINGFIELD, MASS.—Plans are being prepared for increasing the supply. It is thought that a reservoir on Day brook would cost $100,000, while the height of the dam of the upper reservoir could be increased 10 ft. at a much less cost.

WEST SPRINGFIELD, MASS.—The contract for a 25 x 50 ft. iron standpipe has been awarded to the R. F. Hawkins Iron Works, at $3,300.

ANDOVER, N. Y.—The contract for constructing works, including the furnishing of valves and hydrants, has been awarded to M. B. Birdseye, Fayetteville, at $7,466. The contract for pipe has not been awarded, according to reports.

FREEPORT, N. Y.—An election will be held Sept. 12 to vote on the question of a supply.

PRATTSBURG, N. Y.—A meeting has been held to consider the question of works.

LOCK HAVEN, PA.—Surveys for a new supply have been prepared by Voorhees & Witmer, Buffalo. The plans include a 12-in. cast iron main to a mountain stream 5½ miles from the city.

SCRANTON, PA.—The Lackawanna Water Supply Co. has been incorporated by F. L. Tayler, G. A. Watts, E. S. Jones, of Blakely; E. A. Jones, of Archbald, and G. S. Horn, of this city; capital stock, $5,000.

SHARPSBURG, PA.—Bids are asked until Sept. 11 for 400 lin. ft. 10-in., 1,016 lin. ft. 8-in., 1,340 lin. ft. 6-in., and 432 lin. ft. 4-in. pipe, and about 12¾ tons special castings. J. P. Farrell, Chn. Com.

CUMBERLAND, MD.—The contract for a 4,000,000-gallon pumping engine has been awarded to the Holly Mfg. Co., Lockport, N. Y., at $17,500, for a Gaskill engine.

PETERSBURG, VA.—Plans are nearly completed for securing an additional supply, for which $30,000 was recently voted.

MANNINGTON, W. VA.—The citizens have voted to issue bonds for $5,000 for works.

KNOXVILLE, TENN.—The Knoxville Water Co. is reported as considering the question of extensions; also of putting in a filter plant at an estimated cost of $60,000.

DANVILLE, KY.—L. A. Smith has been engaged to make surveys for a supply.

FRANKLIN, KY.—A franchise for 20 years will be sold to the highest bidder Oct. 2; population, 2,500. M. B. Harris, Mayor.

ASHTABULA, O.—Engineers are reported as preparing plans for a reservoir on Bunker Hill, estimated to cost at least $15,000.

ATHENS, O.—An election will soon be held to vote on an issue of bonds for $45,000 for works, according to reports.

CELINA, O.—The citizens have authorized the construction of works, and the contract will be let at once.

LOCKLAND, O.—Bids are asked until Sept. 12 for constructing mains. E. O. Buchanan, Vil. Clk.

YOUNGSTOWN, O.—Plans have been prepared for a high-pressure service; estimated cost, $186,000.

EVANSVILLE, IND.—It is proposed to spend $10,000 or $12,000 in securing a temporary supply while new works are being constructed.

ROCHESTER, IND.—We are informed that the city hopes to go on with the construction of works in the spring.

NILES, MICH.—Another election will be held to vote on the question, according to reports.

LAMOILLE, ILL.—It is reported that a large tank will be constructed for fire protection.

MARENGO, ILL.—We are informed that the contract for works will probably be awarded about Oct. 1. The supply will be from wells; estimated cost, $40,000.

SPRING VALLEY, ILL.—The works are being improved, according to reports.

IRONWOOD, WIS.—The city is negotiating with the company for the purchase of the works.

LAWRENCE, KAN.—The citizens are taking steps to secure municipal works.

TOPEKA, KAN.—Bids are asktd until Sept. 18 for all labor and material required in the construction of works for the Asylum for Imbeciles and Idiotic Youth, at Winfield. Wm. Wykes, Secy. Bd. Pub. Wks.

ALLIANCE, NEB.—It is reported that works will be constructed as soon as bonds for $17,000 have been sold.

PENDER, NEB.—The citizens have voted to issue bonds for works.

ST. THOMAS, N. DAK.—Works are being put in, according to reports.

BASTROP, TEX.—The question of works is being discussed.

BOWIE, TEX.—The council is reported as negotiating for works and an electric light plant.

MADISONVILLE, TEX.—The citizens are obtaining subscriptions to secure an artesian supply.

SAN ANTONIO, TEX.—George Paschal, Mayor, writes us that the contract for plans for a complete system has been awarded to Samuel Gray, Providence. There will be about 120 miles of mains and the supply will be obtained from artesian wells.

STEPHENVILLE, TEX.—It is reported that arrangements are being made for works.

BOULDER, COLO.—The council has adopted the report recommending a new pipe system estimated to cost $30,076. An election will be held Sept. 12 to vote on an issue of bonds for $50,000.

SANTA FE, N. MEX.—The Santa Fe Water & Improvement Co. has spent $200,000 in improvements during the last year, according to reports, and plans are being prepared for further work during this fall and winter.

WENATCHEE, WASH.—Plans have been prepared for works, according to reports.

REEDLEY, CAL.—The Kings River Water Co. has been incorporated by E. E. Giddings, G. V. P. Day, W. A. Saunders, J. E. Mitchell and M. O. Abbott; capital stock, $150,000.

SAN DIEGO, CAL.—Several propositions for a supply are being considered.

SACRAMENTO, CAL.—At the election, Aug. 26, the citizens voted in favor of the proposed supply, for which the contract was recently awarded.

SUMMERSIDE, PRINCE EDWARD ISLAND.—T. A. Pickett has been examining proposed sources of supply for private parties who contemplate putting in works.

SEWERS.

REVERE, MASS.—At a meeting Aug. 1 the citizens accepted the legislative act relating to a system, and a commission will soon be appointed.

SPRINGFIELD, MASS.—The city engineer has prepared plans for an extension of the Worthington St. sewer into the river; estimated cost, $5,000 to $6,000.

AUBURN, N. Y.—D. F. Austin, Cy. Engr., is designing main sewers for a section of the city. The sewers are planned to carry both sewage and storm water, but will probably not be constructed this year. Chas. C. Brown, Consult. Engr., Schenectady.

GRATWICK, N. Y.—It is reported that at a special election Aug. 31 the citizens voted in favor of raising $60,000 for sewers.

NEW YORK, N. Y.—Bids are asked until Sept. 14 for sewers in Willow Ave. and Union St. Louis F. Haffen, Comr. St. Impvts., Wards 23 and 24.

SYRACUSE, N. Y.—Plans for a trunk sewer in Butternut St., to run under the Oswego Canal and empty into Onondaga creek, have been prepared, but have not yet been acted upon by the council.

ALLEGHENY, PA.—The council has passed ordinances for a system of sewers in the hill districts. There will be six sewers; estimated cost, $51,000.

HOMESTEAD, PA.—Contracts have been awarded to Erbeck Bros. as follows: McClure St. sewer, $4,815; Amity St., $14,264; Dickson St., $15,966.

HUNTINGTON, W. VA.—W. E. Williams, Engr, informs us that because of an omission in the Mayor's proclamation a new election for the issue of bonds must be held, and the contracts recently awarded for the Third Ward sewer system will have to be relet. It is not probable now that the work will be done this year.

CINCINNATI, O.—Bids are asked by the board of administration until Sept. 12 and 26 for sewer and drains.

CLEVELAND, O.—Bids are asked until Sept. 12 for sewers in two streets.——Plans have been prepared for sewers in ten streets. J. H. Farley, Dir. Pub. Wks.

BRIDGE.—New York, N. Y.—The following bids were received Aug. 29 for the construction of a bridge over the Harlem River on the line of Third avenue, between 129th and 135th streets: 1, M. S. Coleman, New York; 2, Jno. J. Hopper, New York (lowest bidder); 3, Rodger & Farrell, New York; 4, Hart Anderson & Barr, Brooklyn; 5, Andrew Onderdonk, Chicago; 6, Sooysmith & Co., New York; 7, Steward & McDermott, New York; 8, Clinton Stephens, Brooklyn. The totals have not yet been made public.

	1.	2.	3.	4.	5.	6.	7.	8.
Temporary Bridge:								
Yellow pine timber, 107,500 ft. B. M.	50.00	40.00	45.00	38.00	33.00	53.00	40.00	40.00
Hemlock “ 200,000 “ “	35.00	30.00	30.00	28.00	26.00	48.00	23.00	30.00
Spruce “ 30,000 “ “	35.00	34.00	45.00	32.00	27.00	48.00	40.00	35.00
Spruce piles, 16,750 lin. ft.	.23	.22	.30	.22	.25	.35	.20	.20
Bolts, nails, etc., 20,000 lbs.	.04	.03	.05	.05	.04	.04½	.04½	.04
Iron and steel in draw-span, 112,000 lbs.	.05	.04	.06	.04$\frac{1}{5}$	.04	.05$\frac{3}{100}$	.06	.05
Removing buildings and grading approaches	5,000.00	100.00	5,000.00	5,000.00	500.00	2,000.00	450.00	1,000.00
Engine-house on temporary draw-span, complete	15,000.00	1,200.00	2,500.00	500.00	1,200.00	1,000.00	1,500.00	2,000.00
Maintaining and operating temporary bridge	600.00	225.00	800.00	400.00	200.00	1,350.00	750.00	600.00
Removing temporary bridge	5,000.00	500.00	1,000.00	5,000.00	500 00	00.00	100.00	100.00
Removing Old Bridge:								
Removing bridge now standing	5,000.00	500.00	10,000.00	12,000.00	100.00	5,000.00	3,000.00	10,000.00
Bridge Guard:								
Yellow pine timber, 140,000 ft. B. M.	50.00	60.00	45.00	60.00	55.00	50.00	55.00	45.00
“ “ piles, 20,000 lin. ft.	.30	.37	.35	.45	.47	.47	.45	.30
Iron bolts, washers, etc., 10,000 lbs.	.04	.03	.05	.05	.04	.03½	.04½	.04
Cofferdams:								
Cofferdam at south approach	6,000.00	3,500.00	6,000.00	3,500.00	7,500.00	6,700.00	4,000.00	5,000.00
“ “ north “	6,000 00	3,500.00	6, 00.00	3,500.00	8,000.00	4,500.00	5,000.00	7,000.00
Excavation and Embankment:								
Dredging, 1,000 cu. yds.	.40	1 00	1.00	1.50	1.75	.50	.50	1.00
Excav. approaches above high water, 19,000 cu. yds.	.50	1.00	.50	.60	1.75	1.90	.70	.50
“ south approaches below high water, 6,000 cu. yds.	1.00	2.15	2.00	1.00	1.50	1.90	2.00	1.00
“ “ arcades “ “ “ 3,000 “ “	1.00	2.15	1.50	1.00	1.50	1.90	2 75	2.00
“ north arcade “ “ “ 9,000 “ “	1.00	2.50	1.50	1.00	1.50	1.90	3 50	2.00
“ “ approach “ “ “ 4,000 “ “	1.00	1.60	1.50	1.00	1.50	1.90	1.50	1.00
Rock filling, hand laid slopes, 4,000 cu. yds.	2.50	.75	2.00	1.00	2.50	6.50	1.75	.50
Earth “ 12,000 cu. yds.	.50	.25	.50	.60	.30	1 25	.35	.25
Foundations:								
Pneumatic caissons, including concrete filling, 5,000 cu. yds.	35.00	29.00	36.00	35.00	37.50	27.00	40.00	25.00
Oak piling, 5,000 lin. ft.	.50	.40	.30	.40	.45	.55	.65	.40
Spruce piling, 140,000 lin. ft.	.23	.22	.20	.22	.25	.40	.30	.20
Yellow pine caps and platforms, 50,000 ft. B. M.	50.00	36.45	40 00	40.00	33.00	33.00	40.00	40.00
Hemlock caps and platforms, 650,00 ft. B. M.	35.00	27.00	25.00	25.00	26.00	33.00	25.00	20.00
Iron drift bolts, etc., 54,000 lbs.	.04	.04	.05	.05	.04	.03½	.04	.04
Gravel filling, 500 cu. yds.	2.50	1.50	2.00	1.50	1.50	1.75	1.75	1.50
Concretes:								
No. 1, Port. cem., exclu. of that inside caissons, 3,600 cu. yds.	9 50	9.00	7.50	10.00	7.00	8.00	12.00	8.00
No. 2, Am. cem., in arcades and app., 17,000 cu. yds.	7.00	5.40	6.00	6.00	4.20	6.50	4.50	4.50
River Masonry:								
Ashlar facing in piers below low water, 2,000 cu. yds.	25.00	14.00	25 00	15.00	19.00	19.50	18.00	12.00
Granite ashlar above low water, 1,500 cu. yds.	30.00	20.00	25.00	26.00	23.00	23.50	29.00	25.00
Land Masonry:								
Coursed ashlar in arcades, 900 cu. yds., gneiss	50.00	19 00	22.00	14.00	18.50	19.00	21.00	20.00
“ “ “ “ “ “ granite	50.00	23.00	25.00	25.00	19.75	22.00	25.00	25 00
Uncoursed ashlar in arcades, 3,200 cu. yds., gneiss	50.00	21.50	18.00	12.00	24.50	20.00	21 00	15.00
“ “ “ “ “ “ granite	50.00	25.50	22.00	2[illegible].00	25 00	23.00	23.00	20.00
Parapet walls, 600 cu. yds., gneiss	60.00	23.00	20.00	16.00	23.00	30 00	33.00	40.00
“ “ “ “ granite	60.00	23.00	25.00	30.00	23.00	40.00	35.00	50.00
Rubble backing, 2,500 cu. ft.	7.00	5.40	6.00	6. 0	6.00	18.00	4.50	6.00
Enamel brick facing of walls, 400 sq. ft.	2.50	1.00	.50	1.00	.75	.35	1.00	1.25
White “ “ “ “ 7,500 sq. ft.	1.00	.50	.50	.50	.50	.25	.80	.75
White brick facing of arches, 6,000 sq. ft.	1.00	.75	.50	.50	.50	.25	.80	.75
Brick in backing and arches 900 cu. yds.	12.00	12.00	10.00	12.00	12.00	9.00	11.50	14.00
Waterproofing of arcades, 31,000 sq. ft.	.30	.15	.20	.10	15	.20	.25	.15
Granite bridge seats below roadway, 9,000 cu. ft.	2.00	1.90	2.25	2.00	1.90	1.60	1.75	2.00
Bluestone plate course below 15-in. beams, 1,000 cu. ft.	2.00	1.25	2.00	1.00	1.30	1.00	1.50	1.00
Portland cement, extra, 200 bbls.	3.00	2.40	3.00	3.00	2.25	2.50	2.50	2.50
American rock cement, 200 “	1.50	1.25	1.50	1.25	.90	1.25	1.25	1.25
Fine Cut Stonework:								
Granite caps of piers above roadway, 3,500 cu. ft.	2.50	2.50	2.30	3.60	3 00	2.75	2.65	3.00
“ coping of app. parapets, 3,000 cu. ft.	2.50	3.00	2.30	3.60	3.50	3.25	2.65	3.00
“ “ arcade “ 2,700 “	2.50	3.50	2.50	4.00	4.20	3.75	3.75	3.25
“ columns, capitals and bases, 2,400 cu. ft.	2.50	2.00	2.00	3.00	2.35	2.10	2.25	2.00
“ fenders, 100 cu. ft.	2.50	1.50	2.50	1.50	2.00	1.70	1.75	3.00
Voussoirs and skewbacks, 8,000 cu. ft., gneiss	2.50	1.00	1.75	1.00	1.70	1.50	2.25	1.50
“ “ “ “ granite	2.50	1.75	2.00	1.50	1.70	1.60	2.25	2.00
Bluestone steps, 2,000 cu. ft.	2.00	2.40	2.00	2.00	3.50	4.00	3.50	2.00
Dimension granite in rough, 100 cu. ft.	1.50	.50	1.25	.60	.65	.75	1.00	1.00
Additional Stone Dressing:								
Rough pointing, 100 sq. ft.	.50	.40	.50	.35	.96	.90	.40	.60
Fine “ 100 “	.75	.50	.60	.50	1.20	1.15	.55	.70
Four-cut axing, 100 “	.75	.50	.75	.70	1.10	1.10	.65	.90
Six-cut “ 106 “	.85	.60	1.00	.80	1.37	1.35	.85	.95
Eight-cut “ 100 “	1.00	.70	1.25	.90	1.54	1.50	1.00	1.00
Steel and Iron:								
Rolled steel and iron in turntable, 382,000 lbs.	.07	.04$\frac{3}{5}$	.06¼	.04$\frac{55}{100}$	.05	.04$\frac{84}{100}$	.07	.05
“ “ “ drawspan, 1,692,000 “	.05	.03$\frac{9}{10}$	.04	.05$\frac{55}{100}$	.03$\frac{9}{10}$	.03$\frac{94}{100}$	.05½	.04
“ “ “ deckspans, 1,386,000 “	.04½	.03$\frac{7}{10}$	.04	.04$\frac{15}{100}$	.03½	.03$\frac{7}{10}$	.04½	.04
Corrugated plates, deckspans, 420,000 lbs.	.04	.03$\frac{35}{100}$	.04	.03$\frac{7}{10}$	.03	.03$\frac{35}{100}$	.04¾	.03
Buckle “ drawspans, 357,000 “	.04	.63$\frac{1}{5}$	.04	.03$\frac{3}{5}$	.03	.03$\frac{1}{5}$	.04	.03
Steel plate girders in arcades, 282,000 “	.04	.03$\frac{33}{100}$	.04	.04$\frac{15}{100}$	.02$\frac{7}{10}$	.03$\frac{33}{100}$	.04½	.02$\frac{7}{10}$
“ rolled beams “ 420,000 “	.04	.02$\frac{6}{10}$	.04	.03¼	.02$\frac{3}{10}$	.02$\frac{57}{100}$	.04	.02$\frac{3}{10}$
“ castings in wheels, etc., 117,800 “	.08½	.07	.07	.09¼	.07½	.08$\frac{99}{100}$	.10	.07½
“ “ hub and bedplates, 126,000 lbs.	.08	.05	.05	.08$\frac{35}{100}$	.06	.08$\frac{99}{100}$	.10	.06
Other iron castings, 2,000 lbs.	.03	.02⅙	.03½	.03$\frac{65}{100}$	.02½	.02$\frac{43}{100}$	.06	.04
“ steel or iron plates or angles, 35,000 lbs.	.05	.02½	.04	.04$\frac{15}{100}$	.03½	.02$\frac{73}{100}$	.04¼	.04
Painting:								
Second coat of paint, 26,300 sq. yds.	.10	.18	.15	.10	.25	.14	3,945.00	.25
Third “ “ 19,000 “	.10	.13	.10	.10	.20	.12	2,280.00	.20
Fourth “ “ 15,000 “	.10	.11$\frac{1}{5}$	.08	.10	.15	.11	600.00	.30
Engine-House and Machinery:								
Engine-house on drawspan	4,000.00	3,300.00	2,500.00	1,600.00	2,500.00	3,300.00	3,000.00	2,500.00
Boilers, engines, etc., for revolving drawspan	10,000.00	9,700.00	13,500.00	15,000 00	15,500.00	9,70 .00	18,000.00	20,000.00
Device for supporting ends of drawspan, complete	4,000.00	3,100.00	3,000.00	4,000.00	4,200.00	3,100.00	4,300.00	3,500.00
Electric Lighting:								
Electric light plant	12,000.00	11,000.00	5,000.00	16,000.00	12,000.00	17,000.00	13,000.00	17,000.00
Pavements of Bridge:								
Granite paving, on concrete, 6,200 sq. yds.	4.00	3.00	3.50	4.60	3.75	3.50	3.70	4.00
“ “ without “ 2,700 “	3.00	2 50	3.00	4.00	3.00	2.50	3.00	3.00
Asphalt, 5,200 sq. yds.	4.00	3.25	3.80	3.25	3.25	4.50	3.50	3.00
Bluestone flagging on drawspan, 6,000 sq. ft.	.40	.80	.28	1.50	.75	.70	.75	1.00
“ “ deckspan, 9,000 “	.40	1.00	.28	1.50	1.10	1.10	.75	1.00
“ curb “ “ 900 lin. ft.	1.00	1.00	.60	1.50	1.25	1.00	1.50	1.25
General:								
Cornice and railing, 1,048 lin. ft.	4.50	13.50	8.00	13.50	10.00	13.50	16.00	11.00
Iron in gates and posts at ends of deck spans, 6,000 lbs.	.05	.15	.04	.30	.16	.30	.15	.12
Cluster lamps, 42.	100.00	100 00	125.00	95.00	85.00	95.00	85 00	175.00
Bracket “ 60.	100.00	15.50	50.00	20.00	11.50	20.00	16.00	40.00
Cast iron catch basins, 20	100.00	15.00	8.00	15.00	10.00	15.00	27.00	20.00
Nine-inch drainpipe, 1,000 lin. ft.	.50	.25	.30	.75	.25	1.00	.40	.35
Four-inch cast iron downfalls 200 lin. ft.	50	1.00	.40	.25	.50	1.00	1.10	.50
Cast iron gratings and spouts, 12	20.00	5.00	4.00	5.00	21.00	5.00	25.00	10.00
Bronze handrail, 2,000 lbs.	.50	.42	.15	.50	.40	50	.45	.20
Bronze tablet, in place	500.00	460.00	250.00	600.00	400.00	500.00	625.00	700.00
Drinking fountain, with attachments	800.00	200.00	500.00	400.00	700.00	447.00	750.00	800.00
Iron aprons, etc., at ends of draw span, 3,000 lbs.	.05	.06	.05	.05	.06	.06	.10	.06
Engineer's office to be provided	5,000.00	500.00	2,500.00	1,500.00	500.00	1,500.00	1,200.00	1,000.00
Necessary Street Improvements:								
Removing houses and regulating new street	5,000.00	50.00	4,000.00	5,000.00	1,000.00	500.00	1,500.00	1,000.00
48 × 32-in. brick sewer, 100 lin. ft.	12.00	10.00	10.00	10.00	12 00	15.00	5.00	12.00
48 × 32-in “ “ 1,300 “ “	12.00	11.00	10.00	10 00	12.00	15.00	5.00	10.00
18-in. glazed pipe sewer, 50 “ “	6.50	2.50	.50	2.00	3.00	7.00	2.40	3.50
15-in. “ “ “ 50 “ “	6.00	2.00	.50	2.00	2.50	7.00	2.25	3.00
12 in culverts, 220 lin. ft.	5.50	2.00	.50	1.00	2.00	3.00	2.00	2 50
48 × 48-in. wooden temporary sewer, 200 lin. ft.	5 00	5.00	1.50	7.00	7.00	8.00	5.00	7.50
Circular receiving basins, 6	100.00	200.00	15.00	150.00	200.00	250.00	125.00	175.00
Granite crosswalks, 2,600 sq. ft.	1.00	1.00	.75	1.00	1.35	1.50	.80	1.00
Granite paving on concrete, 13,500 sq. yds.	4.00	3.00	3 00	4.60	3.75	3 90	3.70	4.00
Bluestone curb, 1,000 lin. ft.	1.00	.65	.50	1.00	1.25	.90	.60	.75
Bluestone flagging, 12,000 sq. ft.	.40	.25	.25	.60	.35	.35	.30	.25
Crosswalk to be relaid, 3,000 sq. ft.	.20	.15	.10	.25	.15	.15	.25	.20
Curb to be relaid, 1,000 lin. ft.	.10	.25	.15	.20	.25	.25	.20	.20
Flagging to be relaid, 10,000 sq. ft.	.10	.05	.07	.15	.10	.07	.15	.10
Paving to be relaid, 1,000 sq. yds.	1.00	.30	1.00	.60	.18	.18	1.50	.75

ASHLAND, WIS.—Bids are asked until Sept. 14 for a 10 and 8-in. pipe sewer. E. E. Larson, Cy. Clk.

ELKHORN, WIS.—Plans for a system have been prepared by W. C. Parmley. Whitewater.

ST. LOUIS, MO.—Surveys for Rock Springs district No. 4 have been completed by A. N. Milner and F. W. Morse. The work will include about two miles of brick and pipe sewers.

SEDALIA, MO.—The council has voted to issue bonds for $10,000 for sewer extensions.

SAN ANTONIO, TEX.—Geo. Paschal, Mayor, writes us that the city has contracted with Samuel M. Gray, Providence, for plans. There will probably be about 100 miles of sewers, but the work will not be commenced before the beginning of next year. The question of sewage disposal has not been fully decided.

GRANT'S PASS, ORE.—The citizens are considering the question of issuing bonds for a system, according to reports.

POMONA, CAL.—The local press and many of the large property owners are reported as urging the necessity of a system.

STREETS.

SALEM, MASS.—Bids are asked until Sept. 11 for building a road from Grove St., Salem, to Grove St., Peabody. Chas. A. Putnam, Engr.

HOBOKEN, N. J.—Bids are asked until Sept. 27 for improving Second St. M. V. McDermott, Cy. Clk.

CINCINNATI, O.—Resolutions have been passed to pave six alleys with brick.——The following bids were received for bowldering Montgomery road, from Hunt St. to Gilbert Ave.: Henkel & Sullivan, $78,750; G. W. & J. A. Murray, $84,595; H. McErlane, $84,290; J. Delaney, $80,866.

CLEVELAND, O.—Bids are asked until Sept. 23 for paving Genesee St., between Hough and Wade Park Aves., with brick. J. H. Farley, Dir. Pub. Wks.

HAMILTON, O.—Bids are asked until Sept. 19 for improving Fourth Alley. J. J. McMacken, Cy. Clk.

MARIETTA, O.—Bids are asked until Sept. 30 for paving Gilman St. with brick. L. Mueller, Cy. Clk.

TOLEDO, O.—The following lowest bids were received for paving Jefferson St., from Eleventh to Collingwood Sts.: J. C. Wernert, brick, $18,758; Wm. McMahon, Hallwood blocks, $22,883; H. P. Streicher, Trinidad asphalt, $40,082; Bermudez asphalt, $39,283; Jno. Streicher, cedar blocks, $16,243; metropolitan blocks, $21,843; Malvern blocks, $21,843.

WINTON PLACE, O.—Bids are asked until Sept. 12 for macadamizing Fairview Ave.: Sept. 15 for artificial stone sidewalks in one street; and until Oct. 2 for the purchase of $12,000 of bonds. E. F. Layman, Engr., 64 West Third St., Cincinnati.

ROCHESTER, IND.—Correspondence is solicited with regard to something good and substantial for street crossings. The council has passed an ordinance prohibiting board walks, and concrete walks are being constructed. Jud. D. Ault.

PORT HURON, MICH.—The council has ordered the paving of several streets.

ELECTRIC LIGHT AND POWER.

LOWELL, MASS.—The city has awarded a contract to the Lowell Electric Light Co. for five years at 36 cts. per light per night for the first year and 34 cts. per night thereafter, each light to be of 2,000 c. p., and burn from one-half hour after sunset till half an hour before sunrise in the morning, except on dark days, when the lights are to burn from sunset till sunrise.

WILLIAMSBRIDGE, N. Y.—Bids are asked until Sept. 15 for lighting the streets by electricity, gas or naphtha, for 1, 3 or 5 years. Robt. Wallace, Vil. Clk.

SMYRNA, DEL.—Bids are asked until Sept. 13 for an electric light plant. O. B. Voshell, Secy. Bd. Comrs.

COLUMBIA, S. C.—The city is reported as figuring on a municipal electric light plant. It is thought that three 50-arc light dynamos can be put in for $10,000, and that the wiring will not cost over $5,000. The city is now paying $100 per year for arc lights and $18 each for incandescent lights.

AURORA, IND.—The Aurora Gas. Co. has offered to light the city at $55 per year for each 1,200-c. p. light.

KALAMAZOO, MICH.—The city clerk has been instructed to notify the Kalamazoo Electric Lighting Co. that the city wishes to terminate its contract for lighting on March 1, 1894, as more lights and a lower price are desired.

BOISE CITY, IDAHO.—The city wishes electric lights at cheaper rates than it is now paying. Peter Sonna, Mayor.

OTTAWA, ONT.—The committee has recommended that the city establish a municipal lighting plant as soon as the present contract expires; also that an engineer be employed to report on the Chaudiere water power.

NEW COMPANIES.—Pennsylvania & New Jersey Power Co., Trenton, N. J.; $500,000; to construct a dam across the Delaware River near Trenton and to supply electricity for lighting and power purposes to Trenton and Morrisville; Wm. S. Stryker, B. Lee, J. T. Ball, W. H. Skirm, G. B. Gray and J. L. Kuser, Newark.——Pontiac Light, Heat & Power Co., Pontiac, Ill.; $20,000——Lititz Electric Light, Heat & Power Co., Lititz, Pa.; $4,200; J. C. Brobst, A. B. Long, P. B. Bucher.——Electric Battery Co., Portland, Ore.; $100,000; Chas. H. Brown, A. P. Armstrong, T. W. Lewis.

CONTRACT PRICES.

ASPHALT PAVING.—Williamsport, Pa.—The contract for paving West Third St. with Trinidad Lake asphalt has been awarded to the Sicilian Asphalt Paving Co., New York, at $3 per sq. yd., less 5% for cash. The Barber Asphalt Paving Co., New York, and the Vulcanite Paving Co., Philadelphia, bid a little above this price. The specifications call for a 6-in. concrete foundation, with Portland or Hoffman Rosendale cement, a wearing surface of 2½ ins. and for maintenance for seven years.

Toledo, O.—Bids for paving Jefferson St. with asphalt ranged from $2.17 to $2.39 per sq. yd.

BRICK PAVING.—Reading, Pa.—Bids for paving North Sixth St. with vitrified brick have been received at $2.40 and $2.50 per sq. yd. on concrete, or $2.25 on broken stone.

Lancaster, Pa.—The contract for paving East Marion St. with brick has been awarded to J. G. Galbraith at $2.15 per sq. yd., with 17 ins. excavation. The bid was $1.98 with 14 ins. excavation.

ASPHALT AND BRICK PAVING.—Terre Haute, Ind. —The lowest bids for paving seven streets ranged as follows: Warren-Scharf Asphalt Paving Co., asphalt, $2.35 to $2.55 per sq. yd.; J. E. Voorhees & Co., brick, $1.87; Cox & Wheeler, brick, $1.63 to $1.67; I. W. Kinser & Son, brick, $1.98 and $2.28.

STONE SIDEWALKS.—Buffalo, N. Y.—Bids for stone sidewalks ranged as follows: Blue stone, 22 to 25 cts. per sq. ft.; sandstone, 26 and 27 cts.; artificial stone, $2.70 and $2.75 per sq. yd.; grading, 39 to 75 cts. per cu. yd.

STONE PAVING BLOCKS.—Salt Lake City, Utah.—Bids for 18,000 sq. yds. stone paving blocks, to be delivered f. o. b. cars in this city, ranged from $1.75 to $2.19 per sq. yd., the lowest bid being that of W. J. Wabel, Park City.

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill.—Maj. A. Mackenzie, U. S. Engineer Office, has recommended that the contract for dams and shore protections between Quincy Bridge and Hannibal, Mo., be awarded to Patterson Bros., Keokuk, Ia., at 43 cts. and $1.09 per cu. yd. respectively for bush and rock in place, 25,000 cu. yds. of each. Other bids ranged from 50 to 80 cts. for brush and $1.20 to $1.43 for rock.

SEWERS.—Utica, N. Y.—The contract for the Hotel St. sewer has been awarded to (1) E. D. Broderick, Troy, at $46,973, the only other bid being that of (2) John Marden, Utica, at $60,258. The estimate of C. W. Adams, Cy. Surv., was $52,000. The prices were as follows:

	1.	2.
Sewer plan No. 1, 870 lin. ft., at........	$24.00	$29.00
Sewer plan No. 2, 720 lin. ft., at.........	16.27	18.00
Sewer plan No. 3, 1,090 lin. ft., at.......	8.67	14.00
Sewer plan No. 4, 100 lin. ft., at..........	8.67	16.00
4-ft. cast iron pipe, 36 lin. ft., at.........	10.00	22.00
9-in. catch basin pipe, 100 lin. ft., at....	.70	1.00
House branch pipes, 40, each.............	.60	.90
Manholes, with iron covers, 2, each......	40.00	75.00
Catch basins, 4, each.....................	30.00	50.00
Ashlar or dressed masonry, 75 cu. yds., at	13.50	12.00
Brick masonry, extra, 30 M., at..........	8.50	13.00
Rubble masonry, in mortar, 40 cu. yds., at	6.75	6.00
Concrete masonry, 50 cu. yds., at.........	5.40	6.00
Excavation, extra, 2,000 cu. yds., at......	.50	.80
Loose stone, 100 cu. yds., at..............	3.00	3.00
Hemlock timber, 10 M. ft. B. M., at......	30.00	20.00

MISCELLANEOUS.

COURTHOUSE.—Fort Myers, Fla.—Bids are asked until Oct. 1 for a courthouse for Lee Co. L. G. Thort.

LEVEE WORK.—Alexandria, La.—Bids will be received until Sept. 20 for seven contracts. J. H. Meeker, Pres. Bd. Comrs.

IRONWORK.—Washington, D. C.—Bids will be received until Sept. 12, at the Bureau of Navigation, Navy Dept., for the iron work of a boiler house to be built on the grounds of the Naval Academy, Annapolis, Md. F. M. Ramsay, Ch. Bureau of Nav.

CHANNEL.—Santa Ana, Cal.—The board of superiors of Orange Co. has instructed the county surveyor, S. H. Fireley, to make a survey of the channel of the Santa Ana River through that county and report on some feasible plan for preventing overflows. The bed of the river at present is above the level of the land on either side, and the water is only kept in by willows, etc. It is the intention to make a channel.

DREDGING, ETC.—New York, N. Y.—The following bids were received by Lieut.-Col. G. L. Gillespie, U. S. Engineer Office, for removing 260,000 cu. yds. of material, and constructing crib and pile revetments, Harlem River improvement: Atlantic Dredging Co. (dredging only), $57,800; Morris & Cumings Dredging Co., $125,334; Thomas Potter, $137,340; Anthony M. Clegg, $137,880; P. Sanford Ross, $129,580; Lee McCallum, $176,510.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Schenectady Locomotive Works, Schenectady, N. Y., has delivered two 8-wheel passenger engines to the Cleveland, Cincinnati, Chicago & St. Louis, and is building four more for the same company. Engines previously purchased were reported too heavy for the roadbed and high speed, and these are of a somewhat different design. Each engine weighs 79,500 lbs. on drivers and 40,000 lbs. on trucks, making a total of 119,500 lbs. in working order.

CARS.—The Jackson & Woodin Co., Berwick, Pa., is building 1,000 stock cars for the Texas & Pacific.

The St. Louis Southwestern has reopened its shops at Pine Bluff, Ark., with the full force of 500 men. The additional shops for the building of cars, which are now in course of erection, will be finished in three months and give employment to perhaps an equal force of men.

STEEL RAILS.—The Bethlehem Iron Works, South Bethlehem, Pa., is filling an order for 11,000 tons of steel rails for the Buffalo, Rochester & Pittsburg.

STEEL PLANT.—It is reported that a large steel-making plant using the Adams process is to be established on Lake Erie at some point between Conneaut and Painesville. Thos. Blair, of Pittsburg, and S. J. Massingham, of Genoa, O., are interested.

THE ILLINOIS STEEL CO. is to shut down its South Chicago plant at an early date, and will not resume until the market improves.

THE MOFFETT, HODGKINS & CLARKE CO. has been placed in the hands of Louis V. Booraem, of Montclair, N. J., as Receiver. The liabilities are said to be $900,000 and the assets are worth about $2,000,000 at par, and are actually worth about $1,300,000.

THE HAWLEY DOWN DRAFT FURNACE CO., Chicago, is equipping six tubular boilers with their down draft furnaces for the Massachusetts General Hospital, of Boston; also the entire plant, consisting of 30 250-HP. Babcock & Wilcox boilers for the West End Ry. Co., Boston. All the furnaces controlled by the Cincinnati Gas Light & Coke Co., Cincinnati, 30 furnaces, are being equipped by this company, as also the entire plant of the Bartholomew Brewing Co., of Rochester, and the Brilliant (Pittsburg) and Flushing (Milwaukee) water-works pumping stations. At a recent test of furnaces made by the Brush Electric Co., Cleveland, a saving of 18% over all other furnaces was shown by the Hawley. S. E. Bleyer, Treas.

THE PITTSBURG REDUCTION CO., Pittsburg, Pa., has changed its offices from the location with those of the Pittsburg Testing Laboratory, at 116 Water St., to more commodious quarters at 701 Ferguson Block. Capt. Alfred E. Hunt, Pres.

NEW COMPANIES.—Tuttle Brick Co., Decatur, Ill.; $18,000; B. B. Tuttle, S. A. Tuttle, Hiram Johnson.——St. Louis Tie Co., East St. Louis, Ill; $150,000; Edward R. Conant, John Storlin, W. E. Meyers.——Hercules Ice Machine Co., Aurora, Ill.; $500,000; Edward Worcester, W. H. Cottrell, J. H. Defrees.——Mandel Safety Gate Co., Chicago, Ill.; $150,000; Wm. A. Vincent, H. Anderson, F. W. Coler.

Proposals for Excavating.

SANITARY DISTRICT OF CHICAGO. —TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed

"Proposal for Excavating a Portion of the Main Drainage Channel" will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 4th day of October, 1893, and will be publicly opened by the said Board of Trustees at the regular meeting held that day or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of that portion of the main drainage channel for the said Sanitary District, between Willow Springs and Joliet, Ill., known as contract sections two (2), three (3) and four (4), and consists in all of about 1,484,800 cubic yards of rock, of about 2,179,500 cubic yards of earth, the building of about 76,466 cubic yards of dry rubble walls.

Each of said sections will be treated as a separate contract in canvassing the proposals and making awards. As all awards will be made by individual sections, each bidder must make prices for each section separate and distinct from every other.

Each proposal must be accompanied by a certified check or cash to an amount equal to $3,000, multiplied by the number of sections bid upon.

All certified checks must be drawn on some responsible bank doing business in the city of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $3,000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder to whom an award of any portion of said work may be made appearing within ten days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the section or sections of said work so awarded, and giving a bond satisfactory to said Board of Trustees for the fulfillment of the same in the amount of $100,000 for each section of work awarded him.

All proposals must be made upon blank forms furnished by the Sanitary District and must give the price for each separate item of work.

The bids will be compared on the basis of the engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.
Attest: THOMAS F. JUDGE, Clerk.
Chicago, Ill., Aug. 5, 1893. 32-8t

NORWOOD, O., WATER-WORKS.

Sealed proposals, addressed to Trustees Norwood Water-Works, will be received by the village of Norwood, Hamilton County, Ohio, at the office of J. M. Harper, Engineer, Ninth and Plum streets, Cincinnati, Ohio, up to 12 o'clock noon of September 24, 1893, for the following approximate quantities of material and work pertaining to the construction of the Village Water-Works:

Item No. 1—1,570 tons of cast iron pipe composed of 230 tons of 12-inch pipe, 570 tons of 8-inch pipe, 470 tons of 6-inch pipe, 210 tons of 4-inch pipe, 90 tons of special castings. All f. o. b. cars Norwood, Ohio.

Item No. 2—5 12-inch valves, 25 8-inch valves, 40 6-inch valves, 145 4-inch valves, all of which to include cast iron curbs and covers, 85 two-nozzle port hydrants, including front covers, all f. o. b. Norwood.

Item No. 3—Distributing and laying about 75,000 lineal feet of pipe, including special castings, valves and hydrants.

Bids will be received for items 1, 2 and 3 separately. A bond of $500 must be given as per specifications, and accompany all bids for Item 3 as a security for the execution of the contract.

Bids must be addressed to the Water-Works Trustees, Engineer's office, Ninth and Plum streets, Cincinnati, Ohio.

The right to reject any and all bids is especially reserved by the trustees.

Forms of proposals and specifications can be had on application to

ALFRED SPRINGER,
GEO. PUCHTA,
HENRY RIKHOFF,
Trustees.
J. M. HARPER, Engineer. 36-3t